NATIONAL REPORT PRESENTED BY THE UNITED MEXICAN STATES TO MEET THE REQUIREMENTS OF THE CONVENTION ON NUCLEAR SAFETY 2013-2015

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ABBREVIATIONS AND DEFINITIONS

ACI	American Concrete Institute
ACM	Acoustic Circuit Model
ACQ	Adverse Conditions to Quality
ALARA	As Low As Reasonably Achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
ASB	Acoustic Side Branch
ASME	American Society of Mechanical Engineers
ASSET	Assessment of Safety Significant Events Team
ASTM	American Society of Testing Materials
AVR	Automatic Voltage Regulator
BFF	Backwash Flow Filter
BOP	Balance of Plant
BRAC	BWR Radiation Assessment and Control
BWR	Boiling Water Reactor
BWROG	Boiling Water Reactor Owners Group
BWRVIP	Boiling Water Reactor Vessel and Internals Project
CAP	Corrective Action Programme
CAPG	Corrective Action Programme Group
CAS	Compressed Air System
CENAPRED	National Centre for Prevention of Disasters
CFE	Federal Electricity Commission
CFR	Code of Federal Regulations
CNSNS	National Commission for Nuclear Safety and Safeguards
Co	Cobalt
CONAGUA	National Water Commission
Constitution	Political Constitution of the United Mexican States
ConvEx-3	IAEA International Emergency Exercise
CQAP	Construction Quality Assurance Programme
Cr	Chromium
CR	Condition Report
CRD	Control Rod Drive
CRDH	Control Rod Drive Housing
Cs	Cesium
CST	Condensate Storage Tank
DBA	Design Basis Accident
DBE	Design Basis Earthquake

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DEHC	Digital Electro Hydraulic Control
DICONSA	Department of Food Distribution
DID	Defence in Depth
DNC	No Conduction Device
DN-III	National Emergency Plan
DO	Direction of Operation
ECCS	Emergency Core Cooling System
EDG	Emergency Diesel Generator
EHC	Electro Hydraulic Control
EOP	Emergency Operating Procedure
EPG	Emergency Procedure Guidelines
EPRI	Electric Power Research Institute
EPU	Extended Power Uprate
EREP	External Radiological Emergency Plan
EREPC	External Radiological Emergency Plan Committee
ERO	Emergency Response Organisation
ESREG	European Nuclear Safety Regulators Group
FCRI	Federal Commission for Regulatory Improvement
FEIR	Final Environmental Impact Report
FI	Flow Indicator
FLEX	Diverse and Flexible Coping Strategies
FORO	Hispanic Forum of Radiological and Nuclear Regulatory Bodies
FP	Fire Protection
FPCC	Fuel Pool Cooling and Cleanup
FSAR	Final Safety Analysis Report
FWCS	Feedwater Control System
GV	Governor Valve
Gy	Gray
HIC	High Integrity Container
HPCI	High Pressure Coolant Injection System
HPCS	High Pressure Core Spray
HVAC	Heating, Ventilating, and Air Conditioning
I	Iodine
IAEA	International Atomic Energy Agency
ICHP	Independent Committee of Human Performance
ICRP	International Commission on Radiological Protection
ICT	Information and Communications Technology
IDR	Important Deficiency Report
IEEE	Institute of Electrical and Electronic Engineers
IEP	Internal Emergency Plan
IGSCC	Intergranular Stress Corrosion Cracking

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IIE	Electric Research Institute
IMP	Mexican Petroleum Institute
IMS	Integral Management System
INES	International Nuclear and Radiological Event Scale
INFOMEX	Mexican federal government web-based application to provide information to the public
ININ	National Institute of Nuclear Research
INPO	Institute of Nuclear Power Operations
IORC	Independent Operations Review Committee
IPE	Individual Plant Examination
IPN	National Polytechnic Institute
IRRS	IAEA Integrated Regulatory Review Service
IRRT	IAEA International Regulatory Review Team
IRS	International Reporting System for Operating Experience
ISEG	Independent Safety Engineering Group
ISI	In-Service Inspection
ISO	International Organisation for Standardization
IVVI	In Vessel Visual Inspection
IWB	Requirements for ASME Code Section XI Class 1 Components
IWC	Requirements for ASME Code Section XI Class 2 Components
IWD	Requirements for ASME Code Section XI Class 3 Components
JP	Jet Pump
JTA	Job Task Analysis
km	kilometre
kV	kilovolt
LED	Light Emitting Diode
LER	Licencee Event Report
LOCA	Loss of Coolant Accident
LOOP	Loss off Offsite Power
LVNPS	Laguna Verde Nuclear Power Station
mBq	milli Becquerel
MCR	Main Control Room
MELCOR	Methods for Estimation of Leakages and Consequences of Releases
mGy	milli Gray
Mn	Manganese
mRad	milli Rad
mRem	milli Rem
MSIV	Main Steam Isolation Valve
MSL	Main Steam Line
MSR	Moisture Separator Reheater

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mSv	milli Sievert
MVA	Mega Volt-Ampere
MW	mega Watt
MWe	mega Watt electrical
MWt	mega Watt thermal
NACN	National Advisory Committee of Normalisation
NEA	Nuclear Energy Agency
NEDO	General Electric Licencing Topical Report
NEI	Nuclear Energy Institute
NMX	Mexican Standard
NOM	Mexican Official Standard
NPPD	Nuclear Power Plant's Division of the Federal Electricity Commission
NRE	Notification of Reportable Event
NSCI	Nuclear Safety Cooperation Instrument
NSCMP	Nuclear Safety Culture Monitoring Panel
NSSS	Nuclear Steam Supply System
NSW	Nuclear Service Water
Nuclear Law	Regulatory Law on Nuclear Matters of Article 27 of the Constitution
NUPIC	Nuclear Procurement Issues Committee
NUREG	USNRC Document Series
OBE	Operating Basis Earthquake
ODCM	Off-site Dose Calculation Manual
OECD	Organisation for Economic Co-Operation and Development
OHSAS	Occupational Health and Safety Assessment Series
OLT	Onsite Leadership Team
OQAP	Operation Quality Assurance Programme
OSART	Operational Safety Assessment Review Team
P&L	Profit and Loss
PASS	Post Accident Sampling System
PCB	Polychlorinated biphenyl
PCP	Process Control Programme
PEIA	Preliminary Environmental Impact Assessment Report
PEMEX	Mexican Oil Company
PF	Federal Police
PGA	Peak Ground Acceleration
PIIS	Process Information Integrated System
PMH	Probable Maximum Hurricane
PMP	Probable Maximum Precipitation
PRIS	Power Reactor Information System
PROFEPA	Federal Attorney for Environmental Protection

PSA	Probabilistic Safety Analysis
PSAR	Preliminary Safety Analysis Report
PSR	Periodic Safety Review
PSTG	Plant Specific Technical Guidelines
QA	Quality Assurance
QAP	Quality Assurance Programme
QMS	Quality Management System
RAI	Request for Additional Information
RASCAL	Radiological Assessment System for Consequence Analysis
RCIC	Reactor Core Isolation Cooling
Rem	Roetgen Equivalent Man
RG	Regulatory Guide
RHR	Residual Heat Removal
RO	Reactor Operator
ROP	Reactor Oversight Process
RPV	Reactor Pressure Vessel
RTP	Rated Thermal Power
SAFSTOR	Method that allows the facility to be safely stored and subsequently decontaminated
SAMG	Severe Accident Management Guidelines
SAST	Workplace Health and Safety Administration System
SAT	Systematic Approach to Training
SBO	Station Black Out
SC	Safety Culture
SCART	Safety Culture Assessment Review Team
SCRAM	Sudden Control Rod Action Movement
SCT	Secretariat of Communications and Transport
SEDECO	Secretariat of Economic Development
SEDENA	Secretariat of National Defence
SDH	Standard Design Hurricane
SDP	Significance Determination Process
SEGOB	Secretariat of the Interior
SEMARNAT	Secretariat of Environment and Natural Resources
SENER	Secretariat of Energy
SFP	Spent Fuel Pool
SIL	Service Information Letter
SOER	Significant Operating Experience Report
SORC	Site Operations Review Committee
SPDS	Safety Parameter Display System
Sr	Strontium
SRCM	Storage for Radioactive Contaminated Materials

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SRI	Statement of Regulatory Impact
SRNM	Start-up and Intermediate Range Neutron Monitoring
SRO	Senior Reactor Operator
SRV	Safety Relief Valve
SS	Secretariat of Health
SSC	Structures, Systems and Components
SSE	Safe Shutdown Earthquake
SSEFPS	Safe Shutdown Earthquake Fire Protection System
Sv	Sievert
TEDE	Total Effective Dose Equivalent
TLD	Thermo Luminescent Dosimeter
TMI	Three Mile Island
TMVB	Trans Mexican Volcanic Belt
TS	Temporary Storage
TS	Technical Specifications (Standard Technical Specifications)
TSO	Technical Support Organisation
TÜV	TÜV Anlagentechnik Gmbh
U1	Unit 1
U2	Unit 2
UAM	Metropolitan Autonomous University
UF	Ultra Filtration
UHS	Ultimate Heat Sink
UNAM	National Autonomous University of Mexico
US	United States of America
USA	Utilities Service Alliance
USNRC	United States Nuclear Regulatory Commission
UTM	Universal Transverse Mercator
WANO	World Association of Nuclear Operators
WENRA	Western European Nuclear Regulators Association
Zn	Zinc

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INTRODUCTION
PREPARATION AND SCOPE OF THE NATIONAL REPORT

National policy for nuclear activities

National policy regarding nuclear activities is embodied in The Regulatory Law of the Constitutional Article 27 on Nuclear Matters (hereinafter called "Nuclear Law"). The principle of this Nuclear Law is that nuclear energy must be used only for peaceful applications and that nuclear and radiation safety, and physical security receive the highest priority for all activities, including: siting, design, construction, testing, operation, modification, definitive shutdown, and decommissioning.

Nuclear programme of the United Mexican States

The Federal Electricity Commission (hereinafter called "CFE") is the operator and licence holder of the Laguna Verde Nuclear Power Station (LVNPS) Units 1 and 2. At the cutoff date of this report, Unit 2 was in the final phase of the extended power uprate (EPU) project, with the objective of operating up to 2,317 MWt, which is 120% of the originally licenced rated thermal power (RTP) of 1,931 MWt., while Unit 1 was still operating at 105% (2,027 MWt) of the original RTP.

On June 30, 2015, the head of the Secretariat of Energy (hereinafter called "SENER") presented the document titled "Development Programme of the National Electric System" for the period 2015-2029. This document indicates that three new nuclear power units are being contemplated, with initial dates of operation in 2026, 2027 and 2028. They would be located in the state of Veracruz, at the same site as the two operating LVNPS units.

Preparation, structure and main characteristics of the National Report

In accordance with Article 5 of the Nuclear Safety Convention, this document summarizes the measures taken from January 1, 2013 to December 31, 2015, in relation to LVNPS Units 1 and 2; the only existing nuclear installation in the United Mexican States (hereinafter indistinctly called "Mexico") as far as the Convention is concerned. A description of LVNPS's main characteristics is presented in Table 6.1 in Article 6.

This report is self-contained and organised according to the structure of the 19 articles of the Convention. The report was prepared upon request of the Secretariat of Energy by the National Commission for Nuclear Safety and Safeguards (hereinafter called "CNSNS"), the Mexican regulatory body in nuclear matters, as coordinator, and the Nuclear Power Plant Division of CFE, responsible for the safe operation of LVNPS.

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Declaration of the Contracting Party to the Convention, including a summary of the principal safety issues included in the National Report

The government of Mexico fully recognizes, through this report and its annexes, the commitment to continue pursuing all the fundamental principles of nuclear and radiation safety, and physical security in the Mexican nuclear facilities, in order to maintain and increase their safety level.

The most important safety issues in this report are presented in the following articles:

Article 6 describes the main features of the existing nuclear plant in Mexico. Safety-related issues are discussed, including the events that occurred in the past three years, as well as the projects and measures planned for continuing to improve safety.

Article 7 describes the primary and secondary legislative framework related to nuclear safety, the licencing processes, evaluation, inspection and enforcement during the period covered by this report. The changes in international treaties, bilateral agreements and official Mexican standards are presented in this article's annexes.

Article 8 presents the legal foundations and statutes of CNSNS, the development and maintenance of its finances, and the means it takes to develop and maintain the competence of human resources, the quality control system, as well as the organisation, position, and level of independence of CNSNS within the governmental structure.

Article 9 describes the legal responsibilities of LVNPS's licence holder with respect to safety and the mechanisms CNSNS has to ensure the licence holder meets said responsibility. The article also describes the mechanisms through which the licence holder maintains open and transparent communication with the public.

Article 10 describes the agreements and regulatory requirements implemented by the licence holder to prioritise safety, such as safety culture programmes, including safety management, self-assessment and international agreements for independent safety evaluations, as well as quality assurance programmes.

Article 11 presents the financial situation of LVNPS's licence holder in order to guarantee the nuclear facility's safety during operation, decommissioning, and management of spent fuel and radioactive waste from the nuclear facility. The agreements and standards established by CNSNS for regulating the education, training and retraining of employees and contractors are also described.

Article 12 discusses human factors in the design of the nuclear facilities and subsequent modifications. The concept of a "blackboard" is maintained in both LVNPS control rooms, as

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well as the implementation and adherence to a human performance programme for preventing errors.

Article 13 describes the quality assurance programmes and the quality management systems of LVNPS's licence holder. Additionally, the regulatory review and control activities performed by CNSNS are described.

Article 14 describes the regulatory provisions and requirements for integral and systematic safety evaluations, including their results, as well as those for verifying safety. Also noted is that the request for an extended power uprate (EPU) to 120% PTN is in the final phase of evaluation, and the acoustic-structural evaluation of the steam dryers was the most important issue. A description, in matrix form, of the regulatory inspection programme is included.

Article 15 covers LVNPS's licence holder's processes for reducing radiation exposure and for applying the ALARA (as low as reasonably achievable) principle in all operation and maintenance activities, as well as to the release of radioactive material to the environment. As part of CNSNS's regulatory review and control activities, the strategies in use to reduce the total radiation exposure at LVNPS were reviewed.

Article 16 describes the agreements and regulatory requirements relative for emergency response preparation inside and outside the site, as well as the main elements of the national emergency preparedness plan, including the responsibilities of the regulatory body and other government agencies.

Article 17 covers the regulatory provisions and requirements relative to the location and evaluation of nuclear plants, the impact of the plants on the people, the community and the environment, as well as the regulatory reviews to verify compliance with the requirements.

Article 18 describes the agreements and standards of the Contracting Party concerning the design and construction of nuclear facilities, the implementation of design measures (plant modification and remodelling) including modifications and improvements implemented as a result of LVNPS's EPU to 120%. Post-Fukushima actions are also presented.

Article 19 describes the regulatory provisions and requirements of the United Mexican States that define the safety limits and establish the operational conditions and limits; the general availability of the engineering and technical support necessary in all safety-related areas of the nuclear installations that are encountered during construction, operations or cessation of operations; the regulatory provisions and requirements of the Contracting Party over the licence holders to collect, analyse and share the operational experience; and finally, the regulatory provisions and requirements of the Contracting Party to manage the on-site spent fuel and radioactive waste.

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The conclusion, based on the existing objective evidence, is that the Laguna Verde Nuclear Power Station continues to maintain a level of safety similar to nuclear facilities of the same type located in countries with more nuclear experience. At the moment there do not exist any conditions that can be identified as adverse to safe operation, and thus it is not anticipated that the plant will be shut down before the end of its useful life.

In the opinion of the United Mexican States, it is concluded that Mexico continues to meet the commitments of the Convention on Nuclear Safety.

Information to the public

This National Report, like previous reports corresponding to the 1st, 2nd, 3rd, 4th, 5th and 6th Review Meetings of the Nuclear Safety Convention, as well as the questions made by the Contracting Parties and the answers provided to them, are public documents in compliance with the Mexican "Federal Law of Transparency and Access to Public Government Information," which went into effect on June 12, 2002, and the "General Law of Transparency and Access to Public Information," which went into effect on May 5, 2015, as well as the recommendations from the Convention contained in the document INFCIRC/572/Rev. 5, dated January 16, 2015.

The National Reports for the Nuclear Safety Convention can be downloaded from CNSNS website (www.cnsns.gob.mx) by following the "Seguridad Nuclear" menu link.

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SUMMARY

This document is the seventh National Report of the United Mexican States (hereinafter called "Mexico") for the Convention on Nuclear Safety. This report addresses Laguna Verde Nuclear Power Station (LVNPS) safety issues and the activities of the Mexican regulatory body, the National Commission for Nuclear Safety and Safeguards (hereinafter called "CNSNS"). It describes how the Mexican government achieves and maintains a high level of nuclear safety through the steps it has taken and is taking at its nuclear installations, supporting international cooperation and complying with all the obligations set by the Convention on Nuclear Safety.

The conclusion from the information presented in this National Report is that both LVNPS units continue to maintain a safety performance level similar to other nuclear plants operating in countries with more nuclear experience. Currently there are no identified conditions that might adversely affect safe operation; therefore, there are no plans to prematurely shut down the installation before the end of its licenced lifetime.

Finally, it is concluded that Mexico has the laws, regulations and means for appropriate inspection and supervision by CNSNS, an independent regulatory body, which ensures that LVNPS operation does not present an undue risk to public health and safety, nor to the environment.

– Important safety issues that have been identified in or emerged from previous National Reports

- In relation to the event that occurred at the Fukushima Daiichi plant in Japan on March 11, 2011, Articles 6, 14, 16, 17, and 18 describe how these issues are being addressed by the regulatory body as well as by the Federal Electricity Commission (CFE), the license holder for LVNPS. This information indicates that LVNPS's site and structures as well as the Mexican organisations are taking the pertinent actions to confront the effects of an event like the one at Fukushima Daiichi.

- The Internal Regulations of the Secretariat of Energy (SENER), in Article 39, state that the deconcentrated administrative organisations are hierarchically subordinate to the Secretariat, yet they are given technical and operational autonomy, as well as executive powers to decide matters within the scope of their area of competence. For this reason, and as described in detail in Article 8 (2), although CNSNS is not administratively independent of the organisations responsible for promoting nuclear technology, it is operated with total technical independence.

- As stated in Article 15, since 2006 the trend of reducing LVNPS's collective radiation dose has been continuous. However, by implementing actions and recommendations to protect the vessel internals this trend was reversed. Based on this, the Dose

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Reduction Committee has launched three major actions: control of the source term, improvements in work practices, and reliability of equipment. For this they have implemented strategies and have the Plan of Dose Reduction 2016-2020.

- LVPNS's extended power uprate (EPU) project is in its final stage. The most important issue has been the structural integrity of the reactor steam dryer against acoustic loads, which involved the installation of reinforcements in this component on both units. Another important issue is the process of the Licence Renewal for Commercial Operation for both units, which was initiated in 2015 (See Article 14).

– **Future activities related with safety and proposed or planned programmes for the period until the next National Report**

- Post-Fukushima actions: As described in Article 18, the post-Fukushima actions planned by CFE for LVNPS are divided into three parts, with different commitment dates. 1) Compliance with 10 CFR 50.54(hh)(2) – December, 2016. 2) Stress tests – December, 2017. 3) Compliance with Priority 1 Recommendations – December, 2018.

- Because the license renewal process for both LVNPS units, which was started in 2015, will be largely based on the existing aging programmes, both CFE and CNSNS will focus their efforts on these programmes. They will base their efforts on the experience collected by the USNRC by way of NUREG-1801, which shares the lessons learned about ageing.

– **Attention to the issues that have been identified and agreed to by the Contracting Parties at the Organisation Meetings**

As described in the body of this National Report, Mexico has addressed the issues that have emerged from the Organisation Meetings, including Post-Fukushima actions; effective independence for the regulatory body; sufficient resources to address important safety issues; maintaining competitiveness; ageing of structures, systems and components that are important to safety; communication with the public and transparency; international cooperation; peer reviews; etc.

– **Contracting Party's responses to the results of previous peer reviews, specifically to the challenges and suggestions related to the National Report, as well as any notice or action voluntarily accepted at previous review meetings**

In addition to that described in the preceding paragraph, Mexico has answered, in a timely fashion, the questions presented by other Contracting Parties. Other issues of interest are:

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applications of the reactor oversight process (ROP); assessments of the impact on the safety of the nuclear installations by noncompliance or regulatory framework violations; improvements in the preparation for and response to emergencies; licence holder safety culture programme at LVNPS; ISO 9001:2008 certification for the regulatory body; feedback from operational experience; etc.

- **Significant changes in the Contracting Party's regulatory and nuclear energy programmes, as well as any measures adopted to meet the obligations of the Convention**

  In Mexico there aren't any significant changes in the regulatory programs, as IAEA's regulations already apply, as well as the rules of the country of origin of LVNPS's nuclear steam supply system. However, these have been complemented with a series of official Mexican standards that are described in Annexes 7.3 and 7.4.

  Regarding a possible change in the nuclear energy programmes, the Introduction describes that in 2015 the Secretariat of Energy presented the "National Electric System Development Programme" for 2015-2029, which includes consideration of three new nuclear power units, to enter into service in 2026, 2027, and 2028.

- **Response to the IAEA Generic Safety Observations Report, if provided and if relevant to the particular national situation**

  As described in the prior paragraphs, Mexico has:

  - Addressed the issues suggested at the Organisation Meetings,
  - Responded in a timely fashion to the questions presented by other Contracting Parties, and
  - Taken action to address the recommendations made at the review meetings.

- **Description of policies, plans, and programmes for accepting and following up on feedback from international peer reviews**

  The policy of Mexico has been, is, and will always continue to be to welcome the international peer reviews and address their recommendations. This has been made clear in the Secretariat of Energy, the Federal Electricity Commission (operator and licence holder of LVNPS), and the National Commission for Nuclear Safety and Safeguards (the sole regulatory body for nuclear matters).

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– **Results of the international peer and IAEA missions to the Contracting Party during the review period; progress in the implementation of the findings; and plans for follow-up**

As described in Articles 8 and 11, the regulatory body as well as LVNPS's licence holder have received international reviews and have addressed or are in the process of addressing their observations and recommendations.

– **Measures taken by the Contracting Party to voluntarily share the international peer reviews with the public**

Mexico's National Reports are available for anyone to download from CNSNS's website (http://www.cnsns.gob.mx/seguridad_nuclear/convencion_seguridad_nuclear.php). These reports include the results of the international peer reviews of CNSNS and CFE. The details can be requested from CNSNS or CFE, when their release would violate national laws regarding confidential or proprietary information.

– **Incorporating operational experience, lessons learned, and corrective actions taken in response to accidents and events that were significant to the safety of the nuclear installations**

Based on the Fukushima-Daiichi event, CNSNS has taken various actions to review LVNPS's actual ability to confront a beyond-design-basis event. Among the actions taken that can be mentioned are:

- LVNPS has been required to comply with the regulatory requirements issued by the USNRC.
- The response actions issued immediately by other countries (e.g., Germany, Canada, United Arab Emirates, Finland, France, England, etc.) have been taken into account.
- CNSNS has performed various special inspections and has participated in international meetings to exchange operational experience with other countries.

Thus, it is concluded that the strategies that have been or are in the process of being implemented will contribute to making LVNPS more robust, with the result of increasing reliability, safety, and operation, as they relate to facing beyond-design-basis events like the one that occurred at Fukushima-Daiichi and to avoid, as best as possible, damage to the nuclear reactor, thereby protecting the health of the surrounding population and environment.

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- **Incorporating the lessons learned from emergency drills**

Internal Emergency Plan (IEP):

i. The design and implementation of the IEP's health indicators have identified aspects that require attention, generating action plans to improve the key elements.

ii. The inclusion of critical tasks to training and drills has generated observations based on performance and training plans to correct deficiencies.

iii. The process of acquiring materials during an emergency has been distributed to appropriate personnel and has contributed to strengthening the administration's perception of the IEP and the importance of related activities.

iv. The implementation of a replica of the technical support centre in the simulator has increased the realism of simulations, permitting direct interaction with dynamic parameters displayed in the safety parameter display system (SPDS).

External Radiological Emergency Plan (EREP):

Among the observations made during evaluation of the EREP integrated exercises performed in 2014 was the need to strengthen the training programmes to conform to the EREP's task units and to systemize their implementation, with the intended result that changing personnel won't reduce the response efficiency in case of a general emergency at LVNPS.

- **Incorporating the actions taken to improve transparency and communication with the public**

As described in Article 8, the federal law "Transparency and Access to Public Governmental Information" that went into force on June 12, 2002, establishes guidelines for the classification of governmental information as public, reserved, or confidential. With the establishment of this law, the federal government created the INFOMEX system, through which CNSNS provides information to the public when requested. This has been done without discrimination, in a transparent and open form.

- **Response to the recommendations adopted in the plenary sessions of the previous Contracting Parties review meetings**

The current and preceding National Reports contain the actions that Mexico has adopted and implemented to address the recommendations from the review meetings of the Contracting Parties to the Convention on Nuclear Safety.

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– Attention to the recommendations of the 6th Review Meeting

Challenges identified by the Special Report of the 6th Review Meeting, from the Fukushima-Daiichi accident:

1. How to minimize the distance between Contracting Party improvements: This is addressed in Article 6, "Description of projects and planned measures for continuous safety improvement, on a case-by-case basis, for each type of nuclear installation."

2. How to carry out harmonized emergency plans and response measures: This is address in Annexe 7.1, "International Treaties signed by Mexico related to nuclear fields covered by CNSNS" and in Annexe 7.2, "Bilateral agreements signed by CNSNS."

3. How to make better use of regulatory and operational experience, as well as of international peer reviews: This is addressed in Article 19 (7), "Operational experience feedback"; in Article 8, "Information regarding the IRRS Mission information"; and in Article 10, "Overview of the Contracting Party's arrangements and regulatory requirements regarding policies and programmes to be used by the licence holder to prioritise safety in activities for design, construction and operation of nuclear installations."

4. How to improve regulatory independence, safety culture, transparency, and openness: This is addressed in Article 8, "Means by which effective separation is ensured between the functions of the regulatory body and those of any other body or organisation concerned with the promotion or utilization of nuclear energy, and means by which independence of the regulatory body in making its safety-related decisions is assured"; in Article 10, "Means used by the regulatory body to prioritise safety in its own activities"; and in the Introduction's "Information to the public."

5. How to involve all countries to commit and participate in international cooperation: This is addressed in Annexe 7.1, "International Treaties signed by Mexico related to nuclear fields covered by CNSNS" and in Annexe 7.2, "Bilateral agreements signed by CNSNS."

– Adoption of the three principles of the 2015 Vienna Declaration on Nuclear Safety

The Contracting Parties to the Convention on Nuclear Safety have adopted the following principles to guide them, as appropriate, in the implementation of the objective of the Convention on Nuclear Safety to prevent accidents with radiological consequences and mitigate such consequences should they occur:

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1. New nuclear power plants are to be designed, sited, and constructed consistent with the objective of preventing accidents in the commissioning and operation and, should an accident occur, mitigating possible releases of radionuclides causing long-term offsite contamination and avoiding early radioactive releases or radioactive releases large enough to require long-term protective measures and actions.

   Mexico's Position: This Contracting Party, aware of the relevance of this principle, states that when the projects for the three new nuclear power units described in the Introduction are solidified, the principles will be adopted in the regulatory framework.

2. Comprehensive and systematic safety assessments are to be carried out periodically and regularly for existing installations throughout their lifetime in order to identify safety improvements that are oriented to meet the above objective. Reasonably practicable or achievable safety improvements are to be implemented in a timely manner.

   Mexico's Position: This Contracting Party, aware of the relevance of this principle, states that it has performed and will always continue to perform exhaustive and systematic safety assessments, based on IAEA's safety principles, as well as those of the regulatory framework that applies in the country of origin of the reactor, and always considering the experience arising from international events and incidents.

3. National requirements and regulations for addressing this objective throughout the lifetime of nuclear power plants are to take into account the relevant IAEA Safety Standards and, as appropriate, other good practices as identified inter alia in the Review Meetings of the Convention on Nuclear Safety.

   Mexico's Position: As indicated in the prior principle, this Contracting Party, aware of the relevance of this principle, states that it has performed and will always continue to perform exhaustive and systematic safety assessments, based on IAEA's safety principles. It also states that it will continue to incorporate and address the points and recommendations that arise in the Review Meetings of the Convention on Nuclear Safety.

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ARTICLE 6. EXISTING NUCLEAR INSTALLATIONS

Obligations

"Each Contracting Party shall take the appropriate steps to ensure that the safety of nuclear installations existing at the time the Convention enters into force for that Contracting Party is reviewed as soon as possible. When necessary in the context of this Convention, the Contracting Party shall ensure that all reasonably practicable improvements are made as a matter of urgency to upgrade the safety of the nuclear installation.

If such upgrading cannot be achieved, plans should be implemented to shut down the nuclear installation as soon as practically possible. The timing of the shutdown may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact."

– Existing nuclear installations in United Mexican States

As far as the Convention on Nuclear Safety is concerned, there is a single nuclear installation in the United Mexican States called Laguna Verde Nuclear Power Station consisting of two units with Boiling Water Reactors (BWR) Unit 1 has 2027 MWt of thermal power and 700 MWe net electrical capacity. Unit 2 has 2317 MWt of thermal power and 817 MWe net electrical capacity.

The facility is located in the State of Veracruz in the Gulf of Mexico, 75 kilometres north of Veracruz City.

Table 6.1 provides the main features of both LVNPS units. In the 2013-2015 reporting period there were no new nuclear installations.

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Table 6.1 List of Existing Nuclear Installations

Name	Laguna Verde Unit 1	Laguna Verde Unit 2
Licence No.	CNLV-1/1	CNLV-2/1
PRIS Code	MX-1	MX-2
Type	BWR	BWR
Thermal Power (MWt)	2027	2317
Net Electrical Capacity (MWe)	700	817
Operator	CFE	CFE
NSSS Vendor	General Electric	General Electric
Cooling	Open, Gulf of Mexico	Open, Gulf of Mexico
Construction Start Date	1-October-1976	1-June-1977
First Criticality	8-November-1988	6-September-1994
Grid Connection	13-April-1989	11- November-1994
Commercial Operation	24-July-1990	10- April-1995
Licence Expiration Date	24-July-2020	10- April-2025

- **Overview of important safety-related issues, including events at nuclear installations during the past three years, and measures taken**

The most important safety issues are listed below:

1. Regarding the Probabilistic Safety Analysis (PSA), new developments that help prevent human errors and improve human-machine interaction (see Article 12).
2. Strategic plans for final disposal of medium and low level radioactive waste, construction of a decontamination building and development of financial mechanisms to ensure the installation decommissioning at the end of its lifetime (see Article 11).
3. Adequacy of procedures and controls for compliance with the General Regulation for Radiation Safety and the International Commission on Radiological Protection (ICRP)-26 by the licence holder (see Article 15).

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4. Maintenance of Environmental Qualification of the equipment and components at the nuclear installation (see Article 14).
5. Tracking of individual and collective radiation dose, contamination of personnel, dry solid waste generation, and unplanned exposure to radiation during refuelling outages (see Article 15).
6. Knowledge management, retirement of experienced as well as executive personnel in the industry (power plant, research centres) and CNSNS (see Article 8).
7. CNSNS granted authorisation for the construction and operation of two LVNPS "Storage Areas for Radioactively Contaminated Materials", No. 1 and 2 (see Article 19).
8. CNSNS granted authorisation for the construction of an Independent Spent Fuel Storage Installation (ISFSI) inside LVNPS (see Article 11).
9. CNSNS granted authorisation for the reconditioning and operation of one LVNPS "Storage Area for Radioactively Contaminated Materials" called "4 Naves" (see Article 19).
10. CNSNS granted authorisation for an Extended Power Uprate (EPU) of LVNPS Unit 2 to 2317 MWt.
11. The Corrective Action Programme (CAP) began in 2004, which required the integration of the Corrective Action Programme Group (CAPG). This group began to coordinate the assessments of events in general with increasing emphasis on Root Cause Analysis. Since 2012 the "Tap Root" methodology has been continuously utilized to analyse the events classified as Regulatory Level 1 and Level 2 (Root Cause Analysis).
12. A Performance Improvement Process Committee was formed in 2015, with the mandate to continuously improve performance by implementing and monitoring indicators for the most important processes at LVNPS.
13. In 2015, with support from IAEA Project RLA9080, LVNPS implemented a Safety Culture Continuous Improvement Process (SCCIP), including the formation a group of 20 Ambassadors of Safety Culture. This multidisciplinary team will be responsible for carrying out self-assessments of the safety culture, as well as to provide support to the organisation in implementing the improvements required to influence the safety culture of the Federal Electricity Commission's (CFE, Comisión Federal de Electricidad) Nuclear Power Plant Division (NPPD).

- **Description of projects and planned measures for continuous safety improvement, on a case-by-case basis, for each type of nuclear installation**

Since 1998, LVNPS has implemented a programme to solve the most important safety issues and it seeks the following five objectives: safety, environment, production, human resources, and costs.

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LVNPS has defined as the most important of all five, the improvement of nuclear safety. Topics covered by this programme include, among others, the following:

1. Collective dose reduction (Implemented, see Article 15)
2. Control of Intergranular Stress Corrosion Cracking IGSCC (Implemented)
3. Replacing the suction filters of the Emergency Core Cooling System (ECCS) to avoid clogging (Implemented)
4. Improving the RPV instrumentation to avoid the degasification problem during the reactor vessel depressurisation (Implemented)
5. Installation of a core instability automatic detection and suppression system (Implemented)
6. Second Level of Low Voltage Protection (Implemented)
7. Replacement of the discharge valves of the Reactor Recirculation System, with other valves with improved design (Implemented)
8. Modernization of the LVNPS full scope simulator. The simulator consists of 104 advanced models, new computing platform and new communication interfaces (Implemented)
9. Conversion to Improved Technical Specifications (Ongoing)
10. Implementation of an equipment reliability programme (Implemented)
11. Implementation of a programme for obsolete equipment replacement (Ongoing)
12. LVNPS Modernization and Extended Power Uprate (EPU) submittal to CNSNS for review and assessment (Ongoing)
13. Programme for Radioactive Waste Reduction (Implemented)
14. Programme for Chemistry Index Reduction (Permanent)
15. Improvement programme based on the World Association of Nuclear Operators (WANO) recommendations (Implemented)
16. Systematic Approach to Training (Implemented)
17. Implementation of a Performance Improvement Process.
18. Levels 1 and 2 Condition Reports of the CAP – No Level 1 Actions overdue. Implemented an evaluation of the characteristics of a healthy safety culture in the root cause analysis process.

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19. Installation of anti-vibration systems (AVS) in the reactor recirculation system, in order to eliminate unstable flow-induced vibration (FIV).

20. Chemical decontamination of the Residual Heat Removal (RHR), Reactor Recirculation (RRC) and Reactor Water Cleanup (RWCU) systems of LVNPS Unit 1, as part of the strategies to reduce the sources of contamination, with the focus on the reduction of sources of radiation in the primary systems.

21. CFE submission of the application for operation licence renewal for Units 1 and 2 of LVNPS for 30 years (under evaluation by CNSNS).

22. CFE submitted an application for authorisation of operation for an Independent Spent Fuel Storage Installation (ISFSI).

23. CFE selection and training of a new group of leaders (Succession Plan 2013 – 2028), to ensure that retiring management staff is replaced with competent and trained personnel. The first generation started in 2013 and will finish in 2018, the second generation will run from 2016 to 2021; and the third generation from 2023 to 2028.

Post-Fukushima Daiichi Actions in the Laguna Verde Nuclear Power Station

Actions taken post-Fukushima include the following:

LVNPS is in the process of implementing strategies for makeup water supply and spraying of the spent fuel pool (SFP) (based on Section B.5.b of the USNRC's Interim Compensatory Measures Order EA-02-026), through a portable diesel pump and various sources of makeup water. Beyond the design basis events are being considered and the implementation of the makeup water supply strategy for the SFP for both units is in process. To this end, alternative water supplies are being analysed; one is from the Laguna Verde lagoon, with a supply of more than 72 hours.

According to CNSNS requirements LVNPS implemented a modification for the diversification of instrumentation for Unit 1's SFP. This instrumentation will be able to reliably monitor the parameters of the SFP (level and temperature) during Extended Loss of AC Power (ELAP) events and during beyond design basis conditions. LVNPS's implementation of this modification in Unit 2 will be in 2016.

CFE is developing the FLEX strategies, as defined in the NEI-12-06 Guide "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide", in order to comply with USNRC Order EA-12-049, as required by CNSNS.

As part of the extended station blackout (SBO) at LVNPS, the diesel generators (DG) currently installed in LVNPS are being electrically interconnected, so as to supply power to

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the direct current (DC) battery chargers in order to maintain core cooling functions and integrity of the primary containment during an extended loss of AC power (ELAP) event.

CFE is currently converting its Emergency Operating Procedures (EOP) and developing its Severe Accident Management Guidelines (SAMG) based on the most recent guidelines of the BWR owners group (EPGs/SAGs Revision 3). The new version of the EOP has been validated and verified, its support procedures are currently being improved, and training is scheduled for 2016. The first draft of the SAMG has been developed and reviewed by the associated technical areas, and the Technical Support Guidelines (TSG) are currently being developed. Validation, verification and training for evaluators, decision makers and implementers, as well as other support staff, is scheduled for July-August 2016.

- **Identification of the installations that were required to shutdown**

Currently, there are no identified conditions that might adversely affect safe operation; therefore, there are no plans to prematurely shut down the installation before the end of its licenced lifetime.

- **A statement on the Contracting Party position regarding the continued operation of nuclear installations, including those that do not comply with the obligations stated in Articles 10 - 19 of the Convention; explaining how safety and other issues were taken into account to achieve this position**

Based on the information presented in this and other articles of the National Report prepared to meet the commitments under the Convention on Nuclear Safety; it is concluded that Mexico has laws, regulations and means for adequate inspection and supervision by its regulatory body - independent from the exploitation organisms - which ensures that LVNPS operation does not represent an undue risk to public health and safety nor the environment.

Regarding the specific compliance with the obligations derived from the Convention on Nuclear Safety, the progress and achievements during the reporting period are presented in each of the following articles.

The conclusion from the existing objective evidence, a summary of which is presented in this report, is that LVNPS continues maintaining a safety performance level similar to other nuclear plants operating in countries with more nuclear experience. Currently, there are no identified conditions that might adversely affect safe operation; therefore, there are no plans to prematurely shut down the installation before the end of its licenced lifetime.

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ARTICLE 7. LEGISLATIVE AND REGULATORY FRAMEWORK

Obligations

1. *"Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations.*

2. *The legal and regulatory framework shall provide for:*
   - *i) the establishment of applicable national safety requirements and regulations;*
   - *ii) a licencing system for nuclear installations and a scheme to prevent the operation of a nuclear installation without a licence;*
   - *iii) a system of regulatory inspection and assessment of nuclear installations to verify compliance with applicable regulations and the licence terms;*
   - *iv) the enforcement of applicable regulations and of the licence terms, including suspension, modification or revocation."*

Article 7 (1) Establishing and maintaining a legislative and regulatory framework

– Overview of the primary legislative framework for nuclear safety, including interfacing national legislation

Introduction

This article presents a summary of the laws, standards and regulations that provide legal support to Mexican institutions related to nuclear and radiation safety, and to the nuclear power plant licencing process overseen by CNSNS. The information cited in this article does not intend to reproduce in their full extent the mentioned laws and regulations. However, at the end of this article, additional information is provided, giving a more complete view of the Mexican regulatory framework.

National requirements and provisions

The legislative and regulatory framework under which the principles and obligations deriving from the Convention on Nuclear Safety is based on the Political Constitution of the United

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Mexican States (hereinafter called "Constitution") from which a series of laws, standards and regulations are derived.

The Constitution, in its Article 27, establishes that nuclear energy must be used only for peaceful uses and that the use of nuclear fuels for the generation of nuclear energy, as well as the regulation of its application in all areas, falls within the purview of the Mexican State.

In accordance with the Constitution, the generation of electric power by nuclear means is considered strategic. The public sector is exclusively responsible for such activity, and therefore, the Mexican State has created the organisations and companies necessary for the effective management of such strategic areas under its responsibility.

The Regulatory Law on Nuclear Matters of Article 27 of the Constitution (hereinafter called "Nuclear Law") entered into effect on February 5, 1985, and gives the Federal Electricity Commission (hereinafter called "CFE") exclusively, the right to generate electricity from nuclear fuels. The design and construction of nuclear power plants also falls to this institution, taking into account the opinion of the National Institute of Nuclear Research (ININ). The Nuclear Law also provides that nuclear reactors that do not produce power shall only be operated by the public sector and the universities, institutes and research centres authorised according to the Law.

CFE is a state owned utility, with its own legal identity and assets, and it has technical, operational and management autonomy, as provided in the Law of the Federal Electricity Commission, which went into effect on August 12, 2014. CFE aims to develop business, economic, industrial and commercial activities in pursuit of its objective, generating economic value and profitability for the Mexican State, with a sense of fairness and social and environmental responsibility.

Likewise, the Constitution in its Article 89, Fraction I empowers the President of the Republic to "promulgate and execute the laws issued by the Congress of the Union, providing the administrative support for allowing its exact observance". Hence the Federal Executive Branch, through the Secretariat of Energy (hereinafter called "SENER") regulates and supervises compliance with the provisions on nuclear safety and safeguards. This attribution is based on Article 33, Fraction XIII of the Organic Law of the Federal Public Administration.

By virtue of Article 17 of the Organic Law of the Federal Public Administration, Mexican State Secretariats are authorised to delegate to deconcentrated and subordinated administrative bodies to provide more effective attention and more efficient dispatch of matters of their competency. These organisations shall have specific powers to resolve matters within the

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territory and competence determined in each case, in accordance with applicable legal provisions.

From the administrative standpoint, this article supports the creation of CNSNS. Being a deconcentrated body under SENER, CNSNS serves as the regulatory body responsible for overseeing nuclear and radiation safety, physical security, and the safeguards within the national territory. By way of SENER's Internal Regulations, these responsibilities have been delegated from the Secretariat of Energy to the Director General of CNSNS.

The Organic Law of the Federal Public Administration empowers SENER to exert the rights of the State on nuclear energy matters, based on the utilization of assets and natural resources, such as radioactive minerals among others, required to generate, transmit, transform, distribute, and supply electricity whose objective is to provide public service and "to conduct and supervise the generation of nuclear energy" (Article 33, Fractions II and III, respectively).

As stipulated in Article 17 of the Nuclear Law, as the nuclear fuel is property of the State, the Federal Executive Branch may only authorise its use under the terms of this Law and always under the surveillance of CNSNS.

The Nuclear Law establishes in its Article 19 that "safety is essential in all activities involving nuclear energy and it should be considered from the planning, design, construction and operation up to the closure and decommissioning of nuclear and radioactive installations as well as in the disposal and final destination of all the waste."

In accordance with this Law, nuclear safety is defined as the "set of actions and measures to prevent the equipment, materials and nuclear installations and their operation from producing undue risks to the population's health and property, or damage to the the environment" (Article 20). It also defines the objective of the radiation safety as: "to protect workers, the population and their property, and the environment in general, by preventing and limiting the effects that could result from exposure to ionizing radiation"(Article 21).

This Law defines two types of installations: nuclear and radioactive. The first one is defined as "one in which nuclear fuel or material is manufactured, processed, used, reprocessed or stored", and the second as "one in which radioactive material or equipment containing it, is produced, manufactured, stored, used; or radioactive wastes are treated, conditioned or stored" (Article 3, Fractions II and III, respectively).

According to the Nuclear Law, both nuclear and radioactive installations must have systems for nuclear and radiation safety, and physical security that meet the requirements established in other legal and regulatory provisions of the Law (Article 22, second paragraph). Similarly,

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the Law foresees in Article 27, third paragraph that " nuclear installations shall be staffed with nuclear and radiation safety personnel required, and the head of the corresponding public agency shall be responsible for strict compliance with the applicable regulations."

Regarding to incident notification and management, Article 23 of the Nuclear Law provides that when aware of an incident involving nuclear materials or fuels, radioactive materials or equipment containing them, or conditions that might cause it, CNSNS shall be notified. In these cases, CNSNS might order or carry out the removal of the equipment, tools or materials that imply some risk, for deposit in places that meet the appropriate safety conditions.

The Nuclear Law establishes the bases for implementing a licencing system for both nuclear and radioactive installations, and for the suspension of licence in case of failure to comply with any established condition. For the granting of any licence or permit it is essential for nuclear and radioactive installations to meet the requirements for the siting (selection, survey and evaluation of the location), design, construction, operation, modification, cease of operations, definitive shutdown, and decommissioning established in the regulatory provisions of the Nuclear Law. These requirements shall reflect the risk associated with operations that involve radioactive material, and depending on the activity and radio-toxicity of the isotopes that are present (Article 25 of the Nuclear Law).

Under the provisions of Article 26 of the Nuclear Law, the current Secretariat of Energy is empowered to grant authorisations for siting, design, construction, operation, modification, cease of operations, definitive shutdown, and decommissioning of nuclear and radioactive installations. These responsibilities have been delegated by the Secretariat of Energy to CNSNS according to Article 42, Fraction XVIII of SENER's Internal Regulations.

The authorisations for the construction and operation of nuclear installations will only be granted by presenting relevant information on how the safety objectives will be met and which procedures and methods will be used during the phases of siting, design, construction, operation, modification, cease of operations, definitive shutdown, and decommissioning of the installation, as well as the corresponding radiological emergency plan. Additionally, information on the environmental impact caused by the installation must be included (Article 28 of the Nuclear Law). An authorisation is also required for handling, transport, storage and custody of nuclear materials and fuels, and radioactive materials and equipment containing them (Article 30 of the Nuclear Law).

The Nuclear Law and SENER's Internal Regulations empower CNSNS as the responsible agency for reviewing, evaluating and authorising the bases for the siting, design, construction, operation, modification, cease of operations, definitive shutdown, and decommissioning of nuclear and radioactive installations; as well as everything related to the fabrication, use,

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handling, storage, reprocessing and transport of nuclear fuels and/or materials, radioactive materials and equipment containing them; everything related to processing, conditioning, dumping, and storage of radioactive wastes; and any disposal of them (Article 50, Fraction III of the Nuclear Law and Article 29, Fraction XVIII of SENER's Internal Regulations).

- **Ratification of international conventions and legal instruments related to nuclear safety**

Mexico has committed to implement the safety and health protection measures, as stated in the Informative Circular No. 18/Rev.1, by an agreement with the International Atomic Energy Agency (IAEA) whereby the Agency would assist in the implementation of a project for a nuclear power plant (INFCIRC/203). Thus, Mexico applies and is obligated to comply with the IAEA´s Basic Safety Standards and recommended safety conditions in the corresponding parts of the IAEA's practical guidelines on the "safe operation of nuclear power plants " and the "safe design and construction of reactors"; as well as the IAEA's guidelines on the "organisation of regulatory activities for power reactors", and the "siting of reactors from the point of view of seismic characteristics of the ground".

Additionally, the international treaties that are included in the Mexican legislative framework, once approved by the Mexican Senate, assume the legal status of a Mexican Law. Mexico is signatory of the international treaties listed in Annexe 7.1. Concerning the nuclear area, Mexico has also signed the bilateral treaties shown in Annexe 7.2.

Article 7 (2) (i) National safety requirements and regulations

- **Overview of the secondary legislation for nuclear safety (ordinances, decrees, etc.)**

Since the inception of Laguna Verde Nuclear Power Station (LVNPS) project, government authorities decided that, in addition to applying the regulations of the International Atomic Energy Agency, the regulations of the Nuclear Steam Supply System (NSSS) supplier's country of origin must be applied. This binding requirement is stated in Condition No. 3 of the Licence for Commercial Operation for both LVNPS units. For this reason, Parts 20, 21, 50, 51, 54, 55, 61, 70, 71, 72, 73 and 100 of Title 10 "Energy" of the United States of America Code of Federal Regulations (CFR), and all industry standards and guidelines issued from this title were established as regulatory requirements. Similarly, the Regulatory Guidelines (RGs) issued by the United States Nuclear Regulatory Commission (USNRC) have been adopted, in accordance with the applicability analysis process that is part of CNSNS's internal processes.

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Radiation safety matters are regulated based on the General Regulation for Radiation Safety, which entered into force on November 23, 1988. This regulation stipulates requirements for the dose limit system (Title Third) the licence holder, the party responsible for radiation safety and occupationally exposed personnel (Title Seventh); radiological accidents and preventive or safety measures (Title Ninth); approvals, permits and licences (Title Tenth); and administrative procedures (Title Eleventh). The regulations also cover the requirements for inspections, audits and examinations, as well as sanctions and the motion for reconsideration.

There are also The Regulations for Ground Transportation of Hazardous Materials and Waste, which went into force on April 8, 1993. These regulatory provisions apply for transportation of Class 7 materials "Radioactive Materials". The Secretariat of Communications and Transportation is the competent authority, however, this does not exclude the Secretariat of Energy's authority, through CNSNS, to grant authorisation for transportation of nuclear and radioactive materials.

The Law of Civil Liability for Nuclear Damages is also under the Mexican legislation, and came into force on January 1, 1975. This Law establishes an indemnity financial system for people affected by a nuclear accident. As noted by this Law, the operator (licence holder) is responsible for all damage caused by any nuclear accident occurring in his nuclear installation. For this, the Nuclear Law provides that CFE is the sole entity authorised to generate electricity using nuclear fuels (Article 15 of the Nuclear Law).

Besides the Nuclear Law, there is also The General Law of Ecological Equilibrium and Environmental Protection, which came into force on January 29, 1988 and whose decree by which amends, adds and repeals itself, came into force on June 4, 2012. Article 154, Chapter VII "Nuclear Energy", of this Law states that "The Secretariat of Energy and the National Commission for Nuclear Safety and Safeguards, with the participation, if needed, of the Secretariat of Health, will supervise that the radioactive minerals exploration, exploitation and processing, the use of nuclear fuels, nuclear energy applications and in general, and related activities in nuclear and radioactive installations, are conducted in compliance with the official Mexican standards on nuclear and radiation safety, and physical security to avoid human health risks and ensure the ecological equilibrium preservation and environmental protection, corresponding to the Secretariat of Environment and Natural Resources to carry out an environmental impact assessment."

The above-mentioned Law gives the Secretariat of Environment and Natural Resources the authority to perform the environmental impact assessment. However, it is important to mention that the evaluation of the nuclear installations impact on the environment, from the radiation safety standpoint, corresponds to CNSNS.

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– Overview of regulations and guides issued by the regulatory body

Normalisation is the process of regulating the activities performed by both private and public sectors in different areas, such as nuclear. These instruments can be Mexican Official Standards (hereinafter called "NOM"), Mexican Standards and Reference Standards, which are abided by the provisions of The Federal Law on Metrology and Normalisation.

In regard to the Mexican standards on nuclear and radiation safety, the Mexican government issued the following revisions: NOM-001-NUCL-2013 "Factors for calculating the dose equivalent," NOM-002-NUCL-2015 "Testing leakage and tightness of sealed sources," NOM-004-NUCL-2013 "Classification of radioactive waste," NOM-035-NUCL-2013 "Criteria for the disposal of radioactive waste material," and NOM-041-NUCL-2013 "Annual limits for content and concentration of releases". A complete list of the applicable standards on nuclear matters is presented in Annex 7.3.

– Overview of the process of establishing and revising regulatory requirements, including the involvement of interested parties

One of the duties of CNSNS, as an agency of the Federal Public Administration, is to aid in the integration of the National Normalisation Programme with proposals for Mexican Official Standards (NOM) and issues related to nuclear and radiation safety, physical security, and associated safeguards.

Mexican Official Standards are mandatory technical regulations, issued by competent agencies, establishing applicable rules, specifications, attributes, guidelines, characteristics or directions for a product, process, installation, system, activity, service or, production or operation method, as well as those relating to terminology, symbols, packaging, labelling and those that relate to their enforcement or implementation.

The Federal Law on Metrology and Normalisation establishes a uniform procedure for the preparation of Mexican Official Standards by the agencies of the Federal Public Administration, which is summarised below:

1. The topics to be prepared shall be included in the National Normalisation Programme.

2. The competent agency prepares the standard draft along with its Statement of Regulatory Impact (SRI), reviewing if there are other standards related to the subject. If applicable, the corresponding agencies will coordinate the preparation of a single NOM by subject or sector. Also the Mexican and international standards related to the subject of the standard draft will be taken into account.

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3. The standard draft is submitted to the corresponding National Advisory Committee of Normalisation (NACN) – the stakeholders are included as part of this committee – to receive its comments in a period not exceeding 75 calendar days.

4. The agency that developed the standard draft will answer the comments made by the NACN, within 30 calendar days and will amend the de draft, if required. When the agency submitting the project, considers that the comments risen by the NACN are not justified, it may request the NACN chair the approval of the draft without changes.

5. Once the NACN approves the standard draft, the corresponding agency sends it along with its SRI to the Federal Commission for Regulatory Improvement (FCRI), for its resolution.

6. The agency answers to the FCRI´s comments raised about the standard draft and its SRI, incorporating to these documents the pertinent adaptations and modifications until the FCRI issues its final opinion about them.

7. The standard draft ruled is submitted to the NACN for approval for publication in the Official Gazette of the Federation as a NOM project. The stakeholders including the general public may comment on the corresponding NACN within 60 calendar days.

8. After 60 days, the corresponding NACN will review the comments received and, if appropriate, change the project within 45 calendar days.

9. The NACN will order the publication in the Official Gazette of the Federation of the answers to the comments received and the changes to the project, at least 15 calendar days before the publication of the NOM.

10. Once approved by the corresponding NACN, the NOMs are issued by the competent agency and published in the Official Gazette of the Federation for its implementation.

The NOMs also shall be reviewed every five years and the Technical Secretariat of the National Commission for Normalisation notified about the outcome of the review, otherwise they will no longer be in force.

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Article 7 (2) (ii) System of licencing

- **Overview of the licencing system and processes including types of licenced activity and, where appropriate, the procedure for relicencing**

Description of the licencing system and its processes

According to the provisions of the Nuclear Law, Chapter IV Articles 25 and 28, and Chapter VI Article 50 Fractions III, IV, V, VII and XIII, CNSNS has the authority for reviewing, evaluating and authorising the bases for the siting, design, construction, operation, modification, cease of operations, definitive shutdown, and decommissioning of nuclear and radioactive installations; as well as everything related to the manufacture, use, handling, storage, reprocessing and transport of nuclear materials and fuels, radioactive materials and equipment containing them; and the processing, conditioning, dumping, and storing of radioactive wastes; and any disposal of them.

During the siting authorisation, CNSNS reviews the most important aspects related to the site where the installation will be built, including the parameters that may affect the design, including: the site seismology, severe weather (probable maximum hurricane) and other aspects of interest. Information concerning the current and future distribution of the population is also reviewed.

Subsequently, in accordance with the provisions of the United States 10 CFR for the licencing process, two stages have been established. The first one starts with the formal delivery of the Construction Permit Application including a description of the characteristics of the installation and essentially of the safety systems provided to ensure that installation will not represent an undue risk. The documents submitted to CNSNS by CFE to support LVNPS application, are the following: (1) Preliminary Safety Analysis Report (PSAR) and (2) Preliminary Environmental Impact Assessment Report (PEIA).

During this stage, CNSNS reviewed the design criteria (structural, system and component – SSC - characteristics, nuclear analysis, etc.) and particularly all the issues related to the impact of the site characteristics on the SSC design of the installation, and the impact of the installation on the environment.

During the review stage CNSNS may require additional information to clarify or to supplement the safety reports. Once the review is finished, a report is prepared containing the CNSNS technical opinion on the Construction Permit application and sent to the Secretariat of Energy. Based on CNSNS opinion SENER may to issue the construction permit. The report includes recommendations and conclusions about the installation's safety.

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During LVNPS construction, CNSNS, through audits and inspections, supervised this phase to assure that the installation was built in accordance with the safety analysis report and the conditions set by the aforementioned construction permit.

Once the detailed design of the installation is finalized, the Licence for Commercial Operation can be requested. This requires that another detailed report on the plant's safety be sent to CNSNS. This report is called the Final Safety Analysis Report (FSAR). This document contains the same information as the preliminary report (PSAR); however, the information is no longer generic but specific to the installation. Also a Final Environmental Impact Report (FEIR) is prepared, which includes the environmental monitoring programme to be operative during the whole plant lifetime, to monitor the effect that the installation will cause on the environment. All the measurements performed during at least five years prior to the plant´s operation are used as reference.

The FSAR review by CNSNS includes assessing the actual operation conditions. The acceptance criteria for pre-operational testing, start-up testing (as well as its impact on the accident analysis) and during commercial operation (in the preliminary report they were generic) are reviewed also. The proposed Technical Specifications (TS) are also examined which, once approved by CNSNS, are part of the Licence for Commercial Operation to govern the operation of the installation. The scope of activities for the inspection of the major safety components that will be performed during the plant's lifetime (in-service inspection) is also evaluated. The adequacy of the training of the installation's operation personnel are verified by examinations.

When the construction progress is such that the safety related equipment and component testing can begin, CNSNS's personnel witness the tests and review the results, to verify that the equipment meets the design criteria.

The FSAR original version reflects the plant's detailed design. The FSAR is continuously updated right up to the start of commercial operation. After that, it is updated on a regular basis to reflect the installation's "as built" condition.

In order to support the granting of the Licence for Commercial Operation, CNSNS prepares the technical report named "Safety Evaluation Report" with recommendations and conclusions. It is submitted to the Secretariat of Energy which, following the recommendations and based on Article 26 of the Nuclear Law, may or may not grant the licence.

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Licence Renewal procedure

In March 2015, the licence holder, CFE, submitted to CNSNS a licence renewal application for both LVNPS units. The regulatory framework for this task was established by CNSNS and was implemented by the licence holder in its application. As of the closing date of this National Report, CNSNS is applying the evaluation procedure corresponding to the country of origin of the reactor.

CNSNS and the licence holder are developing the technological skills required to carry out such an activity and are continuing to maintain and improve these skills.

- **Involvement of the public and interested parties within the Contracting Party**

The Nuclear Law does not provide for citizen participation in public hearings. However, information related to the licencing system and its processes is available to the public and interested agencies in accordance with the "Federal Law of Transparency and Access to Government Public Information," which came into force on June 12, 2002, and the “General Law of Transparency and Access to Public Information,” as well as the recommendations from the Convention included in document INFCIRC/572/Rev. 3, dated April 4, 2011.

- **Legal provisions to prevent the operation of a nuclear installation without a valid licence**

The legal provision to prevent the operation of a nuclear installation without a valid licence is stated in Article 26 of the Nuclear Law, which says that "The siting, design, construction, operation, modification, cease of operations, definitive shutdown, and decommissioning of nuclear and radioactive installations require the authorisation of the Secretariat of Energy".

Article 7 (2) (iii) <u>System of regulatory inspection and assessment</u>

- **Regulatory strategies**

CNSNS completed implementation of its new regulatory strategy to carry out an integral and systematic safety review of LVNPS through the Reactor Oversight Process (ROP), following the USNRC practice. In this process, the resources and information obtained through the assessment and inspection procedures that CNSNS has set up are taken advantage of.

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The Reactor Oversight Process is considered an additional method to the deterministic conventional forms of assessment, review and inspection activities that were taking place previously. The current orientation of these activities by CNSNS is an integration of information obtained from both deterministic and probabilistic methods that contributes to a better safety assessment of LVNPS. This is possible through the Reactor Oversight Process.

- **Overview of the regulatory inspection and assessment process with regard to the safety of nuclear installations**

The purpose of the inspections conducted is to carry out an independent performance verification of LVNPS and assess the condition of its facilities, and achieve a high degree of confidence that the safety objectives prescribed or approved by CNSNS are met.

The inspection process allows verifying the safety of LVNPS through a review that makes it possible to determine if the licence holder:

1. Complies with all laws, regulations and applicable licence conditions as well as all the pertinent codes, guidelines, specifications and practices.

2. Is staffed with competent and effective management, has a good safety culture and satisfactory self-assessment systems to ensure the safety of the installation and the protection of the workers, the public and the environment

3. Achieves and maintains the required quality and behaviour regarding both the safety related activities and the installation's Structures, Systems and Components throughout its useful lifetime.

4. Has enough competent personnel to perform its work both safely and efficiently at all times and during all stages of the installation's useful lifetime.

5. Determines, assesses and, at the appropriate time, corrects the deficiencies and the abnormal conditions and, if necessary, they are duly reported to CNSNS.

6. Determines and properly analyses any other safety issue that is not specified in the authorisation nor prescribed in the regulations.

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Moreover, the Reactor Oversight Process allows carrying out a safety assessment of LVNPS, using the information of the findings documented by CNSNS, as well as the reportable events, documented condition reports, and the Performance Indicators provided by the licence holder.

The Reactor Oversight Process is a risk-informed, tiered approach of key performance strategic areas linked to safety cornerstones that are logically aligned towards fulfilling CNSNS's Mission. There are three key performance strategic areas: reactor safety, radiation safety, and physical security; and seven safety cornerstones linked to the key performance strategic areas, covering the essential safety aspects of installation operation. Satisfactory licence holder performance in the seven cornerstones provides reasonable assurance that CNSNS's mission is being accomplished with no further action required. Otherwise, it is necessary to take the steps described later in the Action Matrix.

The seven safety cornerstones are:

1. Initiating events: Limit the event frequency.

2. Core damage mitigating systems: Availability, reliability and capacity.

3. Barrier integrity: Fuel clad, pressure barrier and containment.

4. Emergency preparedness: Appropriate performance in drills and actual emergencies.

5. Public radiation safety: Liquid and gaseous effluents, inadvertent release of solid radioactive waste, environmental radiation monitoring and transport of radioactive materials within the power plant.

6. Occupational radiation safety: Access control, radioactive materials control and application of ALARA criterion.

7. Physical security: Design basis threat and radiological sabotage.

In addition to the seven cornerstones, there are three "cross-cutting" elements common to all of them.

1. Human behaviour or performance.

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2. Safety culture.

3. Corrective Action Programme (CAP)

The oversight process begins by collecting information from two sources: performance indicators, which are reported quarterly by CFE to CNSNS, and the inspections, defined in the Baseline Inspection Programme. The set of indicators and the inspections cover the safety cornerstones and the cross-cutting elements. The process continues with the assessment of this information. For the performance indicators, data is compared against prescribed thresholds, and for inspections, the inspection findings are first prioritised and after this the safety determination process is done by using established procedures.

The performance indicator information (data) and the inspection information (findings) are classified using colour codes. A given colour combination results and the cornerstones affected are known. The resulting information allows assessing the licence holder performance in the period of interest. This evaluation identifies five levels (Action Matrix) from best to worst in relation to safety significance. For each level, there is an associated information level and a regulatory response to the licence holder to correct the situation. This response is gradual and relative to the significance that the licence holder performance has on safety. The response includes meetings at different management levels between CNSNS and CFE, monitoring, supplemental inspections and other actions.

- **Basic features of inspection programmes**

The basic features of CNSNS's inspection programme include a set of inspections both scheduled and reactive throughout the lifetime of the nuclear installation, and inspections to other relevant areas of both LVNPS and its contractors to ensure compliance with regulatory requirements. Inspection methods include the review and assessment of the installation, procedures, records and documentation; supervision by the licence holder, as well as staff interviews; and tests and measurements. Regulatory inspections are conducted by resident inspectors and non-resident subject matter expert inspectors from CNSNS's headquarters. The findings of these inspections are documented in inspection reports prepared by CNSNS's inspecting staff. These reports include the objective, areas inspected, description of the activities conducted, findings and observations, inspection timeline, and conclusions. The reports are distributed. There is also a semi-annual supervision and a follow-up programme of the inspection reports, in order to provide feedback to the Baseline Inspection Programme.

As indicated in Article 14 (2), the inspection frequency depends on the type of activity and its significance for the installation's safety. The baseline inspection programme indicates the

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minimum number of scheduled inspections to be performed during the period in which the installation has an acceptable level of performance. Additionally, the Baseline Inspection Programme includes some inspections to verify: (1) the quality-related areas, (2) supervising groups and (3) the cross-cutting elements.

It should also be noted that sometimes, there might be a need to conduct special inspections focused on: (1) Safety related emerging generic issues; (2) a specific objective when the licence holder performs major manoeuvres, such as functional testing after power changes or replacement of major components; (3) the response to results from the performance assessment using the Performance Indicators and the findings of scheduled inspections; and (4) the response to operational events which should be evaluated on a case by case basis.

Article 7 (2) (iv) Enforcement of applicable regulations and terms of licences

- Power for legal actions

In accordance with the provisions of the Nuclear Law, Chapter IV Articles 34, 35, 36, 37, 38, 39 and 40, and Chapter VI Article 50, Fraction XII, CNSNS has the authority to apply preventive and safety measures, impose fines, execute enforcement actions and decree administrative sanctions.

- Overview of enforcement actions available to the regulatory body

CNSNS prepared the document "Guideline for Assessing the Impact on Safety of Noncompliance or Violations of the Regulatory Framework at National Nuclear Installations," in which the criteria that govern the process of evaluating the impact on safety are established. Similarly, during 2015 review was completed of two procedures that classify the significance of noncompliance or violations, and then propose corresponding legal actions. The first one assigns a significance level based on the evaluation of four factors (actual consequences, potential consequences, impact to the regulatory process, and intentionality). The second procedure uses the significance determination process (SDP) to determine the risk significance. The SDP assigns a colour of green, white, yellow or red, depending on the risk significance. Green corresponds to the lowest risk and red to the highest. Since late 2013 CNSNS has been adopting the process of determining the importance to include different factors on power operation, such as radiation safety, power outages, fire protection, containment integrity, operator qualification, etc. It is planned to complete the adaptation by the end of 2016.

Also during 2015, CNSNS developed, reviewed and approved a third procedure for preparing and performing inspections of the national nuclear facilities. This procedure establishes the

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steps to follow to gather on-site information related to noncompliance or violations that have occurred at a nuclear installation and to appropriately document them in accordance with the applicable administrative laws.

The aforementioned guideline, as well as the procedures, emphasises in the regulatory requirements compliance and it stimulates early detection and correction of noncompliance by the licence holder, as granted by CNSNS. Thus, there are different types of preventive and safety measures, fines, enforcement actions and administrative sanctions that span from summons letters to economic sanctions and, eventually authorisation revocation. In all cases, LVNPS is required to correct the noncompliance, conduct a thorough investigation within an agreed period and take all necessary measures to prevent a recurrence. CNSNS makes sure that LVNPS has effectively implemented all the preventive and corrective measures, and the appropriate improvement actions.

- **Experience with legal actions and enforcement measures**

During the 2013-2015 reporting period, CNSNS, using the guideline and the procedures mentioned in the previous section, assessed all the inspection findings documented by the Direction of Operational Verification and some Event Reports of LVNPS. The majority of the findings have been of low severity level; however, some cases of noncompliance merited a background investigation and/or administrative sanctions, such that in the indicated period CNSNS imposed two fines and three administrative reprimands (sanctions) with summons. Additionally, an administrative sanction procedure for imposing another fine was begun in 2015 and will run through 2016.

It is worth mentioning that in 2015 an investigation that documented the existence of cases of noncompliance was performed. However, CNSNS decided to not impose any sanctions in recognition of the timely and appropriate actions taken by the licence holder. Furthermore, in response to CNSNS's investigation report, the licence holder imposed internal sanctions on those involved in the more severe cases of noncompliance.

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Annexe 7.1 International Treaties Signed by Mexico on Nuclear Matters Applicable to CNSNS

International Atomic Energy Agency

Name	Date of signature	Date of entry into force	Notes
International Atomic Energy Agency (IAEA) Statute	December 7, 1956	April 7, 1958	The signing of this statute makes Mexico an IAEA member state. It contains an amendment to Article VI, adopted in Vienna on September 28, 1970, that is in force and to which Mexico is a party.
Agreement on the privileges and immunities of the International Atomic Energy Agency (IAEA)	July 1, 1959	October 19, 1983	The representatives of the member states will accept the privileges and immunities for IAEA officials and experts.
Treaty for the proscription of nuclear weapons in Latin America	February 14, 1967	September 20, 1967	As stated in Article 14, Mexico commits itself to submit semi-annual reports on the application of safeguards to nuclear materials in the country.
Treaty on the non-proliferation of nuclear weapons	July 1, 1968	January 21, 1969	This Treaty obliges Mexico to keep an accounting and control system of nuclear materials subject to IAEA safeguards.

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Name	Date of signature	Date of entry into force	Notes
Agreement for the application of safeguards related to the Treaty for the Proscription of Nuclear Weapons in Latin America and the Treaty on the Non-Proliferation of Nuclear Weapons	September 27, 1972	September 14, 1973	Article 7 obliges Mexico to establish and maintain an accounting and control system of all nuclear materials subject to safeguards. Article 63 obliges Mexico to report changes in the inventory of nuclear materials and report the nuclear material balance.
Subsidiary arrangements relating to the Agreement for the application of safeguards related to the Treaty for the proscription of nuclear weapons in Latin America and the Treaty on the non-proliferation of nuclear weapons	September 17, 1972	September 14, 1973	Under these Arrangements Mexico is obliged to provide the following: information on facilities and nuclear material located outside them; reports on accounting and changes in the inventory; materials balance, together with the corresponding physical inventory report; and the transfer of nuclear material from or to México.

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Name	Date of signature	Date of entry into force	Notes
Additional Protocol to the Agreements between Mexico and the IAEA for the application of safeguards	March 29, 2004	March 4, 2011	Mexico is obliged to submit information to the IAEA on nuclear facilities and those outside them. Mexico shall prepare a report on the research and development activities related to the nuclear fuel cycle, safeguards operational activities in installations and locations outside the facilities where nuclear material is routinely used. Mexico is obliged to make annual declarations about exports and imports of nuclear material subject to safeguards (basic materials which did not reach the composition suitable for fuel fabrication) and material which is exempted from safeguards, and dual use equipment and non-nuclear material.
Vienna Convention on Civil Liability for Nuclear Damages	April 25, 1989	July 25, 1989	The Convention obliges our country to cover the damage caused by an accident at a Mexican nuclear installation.
Convention on physical protection of nuclear materials	April 4, 1988	May 4, 1988	The Convention obliges Mexico to take appropriate measures, under its national legal framework and in accordance with international law, to ensure that the nuclear materials are protected during their transportation, use and storage.
Amendments to the Convention on physical protection of nuclear materials	Not applicable	August 1, 2012	These amendments update various items included in the Convention, extending coverage to nuclear installations and transportation of nuclear material.

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Name	Date of signature	Date of entry into force	Notes
Convention on prompt notification of nuclear accidents	September 26, 1986	June 10, 1988	This Convention obliges Mexico to be prepared to address radiological and nuclear emergencies, to facilitate the exchange of information with the IAEA and the signatory countries; in addition to provide information to the IAEA about any radiological or nuclear accidents. Mexico is also obliged to establish points of contact for the help and participate in IAEA exercises.
Convention on Reciprocate Assistance in the Event of Nuclear Accident or Radiological Emergency	September 26, 1986	June 10, 1998	The Convention's objective is to provide and / or receive assistance in case of a nuclear or radiological accident. Mexico is obliged to establish points of contact for the help and participate in IAEA exercises.
Convention on Nuclear Safety	November 9, 1994	October 24, 1996	Mexico is obliged to prepare the triennial report on the nuclear safety implemented in nuclear power reactors, participate in meetings of the Contracting Parties and to answer the questions posed by other member countries.
Comprehensive Nuclear-Test-Ban Treaty	September 24, 1996	December 27, 1999	CNSNS was designated as a national technical counterpart to this treaty, taking over control of the installation of seismic stations, radionuclide detection and hydroacoustics, and in the near future, administration of the national data centre.

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Name	Date of signature	Date of entry into force	Notes
Cooperation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean	May 11, 1999	September 5, 2005	Through this agreement, Latin American countries develop technical cooperation projects under the auspices of the International Atomic Energy Agency (IAEA)
International Accord for the Repression of Nuclear Terrorism Acts	January 12, 2006	July 7, 2007	Nuclear crimes are established, requiring states to establish jurisdiction over such offences, as well the exchange of information and assistance between countries.

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ANNEXE 7.2 BILATERAL AGREEMENTS SIGNED BY CNSNS

Name	Date of signature	Date of entry into force	Notes
Australia: Agreement between the governments of Mexico and Australia for cooperation in the peaceful uses of nuclear energy and nuclear material transfer.	February 28, 1992	Exchange of diplomatic notes	None.
Australia: Administrative arrangement on safeguards between the Secretariat of Energy and the Australian safeguards office.	May 26, 1994	May 26, 1994	CNSNS is obliged to submit annual reports on nuclear materials imported from Australia.

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ANNEXE 7.2 BILATERAL AGREEMENTS SIGNED BY CNSNS

Name	Date of signature	Date of entry into force	Notes
Canada: Agreement between the governments of Mexico and Canada for cooperation in the peaceful uses of nuclear energy	November 16, 1994	February 24, 1995 Exchange of diplomatic notes	CNSNS is obliged to submit annual reports on nuclear materials imported from Canada.

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ANNEXE 7.2 BILATERAL AGREEMENTS SIGNED BY CNSNS

Name	Date of signature	Date of entry into force	Notes
Canada: Administrative Agreement between the Canadian Nuclear Safety Commission and CNSNS on import and export of radioactive sources	Exchange of notes on February 6, 2009 and March 25, 2009	March 25, 2009	Through this agreement the parties exchange information about the sending and receiving of category I radioactive sources.
Cuba: Agreement of cooperation on nuclear and radiation safety between the Secretariat of Energy and the Ministry of Science, Technology and Environment of the Republic of Cuba on nuclear and radiation safety	May 24, 1996	May 24, 1996	As part of this Agreement, several international cooperation actions took place.
Spain: Agreement of technical cooperation between CNSNS and the Nuclear Safety Council of Spain	March 8, 1994	March 8, 1994	As part of this Agreement, several international cooperation actions took place.

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ANNEXE 7.2 BILATERAL AGREEMENTS SIGNED BY CNSNS

Name	Date of signature	Date of entry into force	Notes
United States of America: Agreement of cooperation between CNSNS and the USNRC on exchange of technical information and cooperation on nuclear reactor safety and research	September 18, 2012	September 18, 2012	As part of this Agreement, several international cooperation actions took place.
United States of America: Agreement between CNSNS and the USNRC on the exchange of technical information and cooperation on nuclear safety and research issues	June 2, 1997	June 2, 1997	As part of this Agreement, several international cooperation actions took place.
United States of America: Memorandum of cooperation between CNSNS and the USNRC on import and export of some radioactive sources	September 18, 2012	September 18, 2012	Both parties are obliged to confirm radioactive sources delivery and receipt, particularly categories I and II.
Guatemala: Agreement of cooperation between CNSNS and the General Directorate for Nuclear Energy of Guatemala on radiation safety	February 26, 1996	February 26, 1996	As part of this Agreement, several international cooperation actions took place.
France: Agreement of cooperation between the governments of Mexico and France for the development of peaceful uses of nuclear energy	July 30, 2014	August 1, 2015	The parties will develop activities of technical and scientific cooperation in the use of nuclear energy for peaceful purposes.

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ANNEXE 7.2 BILATERAL AGREEMENTS SIGNED BY CNSNS

Name	Date of signature	Date of entry into force	Notes
Russia: Agreement between the governments of Mexico and Russia for cooperation in the field of peaceful use of nuclear energy	December 4, 2013	September 28, 2015	Together they will develop and strengthen cooperation in the field of peaceful use of nuclear energy.
South Korea: Agreement between the governments of Mexico and South Korea for cooperation in peaceful uses of nuclear energy	June 17, 2012	July 14, 2013	Through the framework of this agreement various actions to foster and promote cooperation in the peaceful use of nuclear energy were developed, in accordance with the respective applicable laws and regulations.

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ANNEXE 7.3 SUMMARY OF MEXICAN OFFICIAL STANDARDS APPLICABLE TO NUCLEAR FACILITIES

Standard	Title	Publication date
NOM-001-NUCL-2013	Dose equivalent calculation factors	Dec-6-2013
NOM-002-NUCL-2015	Leak and tightness tests for sealed sources	Oct-26-2015
NOM-004-NUCL-2013	Classification of radioactive waste	May-7-2013
NOM-008-NUCL-2011	Radioactive contamination control	Oct-26-2011
NOM-012-NUCL-2002	Requirements and calibration of ionising radiation monitors	Jun-19-2002
NOM-018-NUCL-1995	Methods to determine activity concentration and total activity in radioactive waste packages	Aug-12-1996
NOM-019-NUCL-1995	Requirements for low level radioactive waste packages for their definitive storage near the surface	Aug-14-1996
NOM-021-NUCL-1996	Lixiviation tests for solidified radioactive waste specimens	Aug-4-1997
NOM-022/1-NUCL-1996	Requirements for a facility for the near-surface, permanent storage of low-level radioactive waste. Part 1. Location	Sep-5-1997
NOM-022/2-NUCL-1996	Requirements for a facility for the near-surface, permanent storage of low-level radioactive waste. Part 2. Design	Sep-5-1997
NOM-022/3-NUCL-1996	Requirements for a facility for the near-surface, permanent storage of low-level radioactive waste. Part 3. Construction, operation, closing, post-closing and institutional control	Jan-14-1999
NOM-024-NUCL-1995	Requirements and calibration of direct reading dosimeters	Aug-5-1997
NOM-026-NUCL-2011	Medical surveillance from occupationally exposed personal to ionising radiation	Oct-26-2011
NOM-028-NUCL-2009	Radioactive waste handling in radioactive facilities that use open sources	Aug-4-2009

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Standard	Title	Publication date
NOM-031-NUCL-2011	Requirements for the qualification and training of the occupationally exposed personal to ionising radiations	Oct-26-2011
NOM-034-NUCL-2009	Selection, qualification and training requirements of personnel in nuclear power plants	Aug-3-2009
NOM-035-NUCL-2013	Criteria for the disposal of radioactive waste	May-19-2000
NOM-036-NUCL-2001	Requirements for facilities for treatment and conditioning of radioactive waste	Sep-26-2001
NOM-039-NUCL-2011	Specifications for exemption from some or all regulatory conditions for practices and sources within a practice that use ionizing radiation sources	Oct-26-2011
NOM-041-NUCL-2013	Annual limits on contents and their concentrations in releases	May-6-2013

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ANNEXE 7.4 SUMMARY OF MEXICAN OFFICIAL STANDARDS APPLICABLE TO NUCLEAR FACILITIES BUT OUTSIDE CNSNS'S COMPETENCE

Standard	Title	Publication date
NOM-002-STPS-2010	Safety conditions - prevention, protection and fire fighting in the workplace	Dec-9-2010
NOM-005-STPS-1998	Health and safety conditions in the workplace for handling, transportation and storing of dangerous chemical substances	Feb-2-1999
NOM-010-STPS-2014	Chemical contaminants in the work environment – recognition, evaluation and control	Apr-28-2014
NOM-011-STPS-2001	Health and safety conditions in workplaces where noise is generated	Apr-17-2002
NOM-012-STPS-2012	Health and safety conditions in the workplace relating to the manufacturing, use, handling, storing or transportation of ionizing radiation sources	Oct-31-2012
NOM-017-STPS-2008	Selection, use and handling of personal protective equipment in the workplace	Dec-9-2008
NOM-018-STPS-2015	Harmonized system for the identification and communication of risks and hazards from dangerous chemicals in the workplace	Oct-9-2015
NOM-052-SEMARNAT-2005	The characteristics, the identification procedure, classification and hazardous waste listings	Jun-23-2006
NOM-053-SEMARNAT-1993	Procedure to perform the extraction test to determine the components that could make a waste hazardous based on their toxicity to the environment	Oct-22-1993

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Standard	Title	Publication date
NOM-054-SEMARNAT-1993	Procedures to determine the incompatibility between two or more wastes considered hazardous by the Mexican official standard NOM-052-SEMARNAT-1993	Oct-22-1993
NOM-133-SEMARNAT-2000	Environmental protection - polychlorinated biphenyls (PCBs) - handling specifications	Dec-10-2001

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ARTICLE 8. REGULATORY BODY

Obligations

1. *"Each Contracting Party shall establish or designate a regulatory body in charge of implementing the legislative and regulatory framework referred to in Article 7. It shall be invested with authority, competence, and appropriate financial and human resources to fulfil the responsibilities assigned."*

2. *"Each Contracting Party shall take appropriate measures to ensure effective independence between the regulatory body functions and any other body or organisation which is concerned with the promotion or utilisation of nuclear energy."*

Article 8 (1) Establishment of the regulatory body

– Legal foundations and statute of the regulatory body

Legal bases

The Mexican regulatory body regarding nuclear safety, radiation safety and safeguards areas is the National Commission of Nuclear Safety and Safeguards (CNSNS), which was established by the Regulatory Law on Nuclear Matters of Article 27 of the Constitution (or Nuclear Law), on January 26, 1979. As mentioned in Article 7 (1), the following articles of the Nuclear Law, amended in 1985, give support to CNSNS's functions: Articles 13, 17, 18, 19, 23, 28, 29, 32, 33, 34, 35, 36, 37 and 50.

Statutes

CNSNS does not have statutes because it is a deconcentrated body under the Secretariat of Energy; it does not have assets or legal personality of its own.

– Mandate, mission and tasks

Mandate

CNSNS was created by the Nuclear Law. Article 50, Section I of this law states that it is a deconcentrated body under the Secretariat of Energy, which serves as the regulatory body responsible for overseeing nuclear and radiation safety, physical security, as well as safeguards within the national territory.

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Mission

CNSNS's mission is: Regulate the nuclear and radiation safety, physical security and generally safeguard the use of nuclear energy to protect the health of the population and the environment, as well as to meet the international commitments for the peaceful use of nuclear energy.

Tasks

The main tasks carried out by CNSNS are: review and assess, authorisation, inspection, development of regulations and guidelines, and enforcement. It also performs other supplemental tasks, such as: emergency preparedness, examination and licencing of nuclear facility control room operators; issuing licences and import permits for the use, transport, and storage of radioactive materials; participation in technical assistance and international cooperation agreements; and independent execution of research and development projects or in association with other regulatory agencies or research centres, or academic institutions.

– Authorities and responsibilities

Authorities

The primary attributions of CNSNS are to propose and enforce the application of nuclear and radiation safety, physical security, and safeguards standards and regulations for the operation of nuclear and radioactive installations, as well as the use, handling, transportation and possession of nuclear and radioactive materials.

Responsibilities

CNSNS's responsibility is setting the bases and preparing the technical reports to grant the permits and licences for nuclear installations by the Secretariat of Energy. In the case of radioactive installations, CNSNS has the authority to grant the corresponding licence. It is also responsible for conducting audits, technical visits, inspections and verifications to nuclear and radioactive installations, including physical security and safeguards. CNSNS has the authority, by law, to decree sanctions to the installations that do not comply with the regulatory framework. Similarly, for the licencing of nuclear installations operators, CNSNS performs the evaluation of candidates through written and simulator-based operational examinations, and grants the operator's licences.

Additionally, according to the General Law of Ecological Equilibrium and Environmental Protection, CNSNS is responsible for reviewing the environmental information contained in the licence applications of future plants, and the periodic reports submitted by operating plants during their operation, both to avoid undue risks to human health and ensure the preservation of ecological equilibrium and environmental protection. However, the

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Secretariat of the Environment and Natural Resources reviews the environmental impact assessment. In addition, CNSNS carries out an environmental monitoring independent from the one done by the licence holder, through an isotopic analysis of environmental samples collected periodically in the LVNPS's vicinity and processed in CNSNS laboratory. The surveillance results allow verifying the consistency of the periodic reports submitted by the licence holder.

– Organisational structure of the regulatory body

Figure 8.1 shows CNSNS's organisation, which has four Deputy Directorates. The four report to the Director General and have the following objectives:

Deputy Directorate General of Nuclear Safety, responsible for proposing the regulations on nuclear and radiation safety, as well as verifying their compliance at nuclear installations.

Deputy Directorate General of Radiation Safety, responsible for proposing the regulations on radiation safety and verifying their application in radioactive installations.

Deputy Directorate General of Environmental Radiation Monitoring, Physical Security, and Safeguards, responsible for the national system of environmental radiation monitoring and for maintaining the national system of safeguards and physical security at nuclear installations.

Deputy Directorate General of Technology, Regulation, and Services, responsible for updating and adapting the regulatory framework and providing technical support on nuclear and radiation safety, physical security, and safeguards required by CNSNS staff. It manages the information and communications technology system.

Deputy Directorate General of Finance and Administration, responsible for managing the human, financial and material resources allocated to CNSNS, in accordance with applicable regulations and policies. It handles or provides the services that are generally required for the maintenance and conservation of the facilities and assets.

CNSNS also has the Directorate of Legal and International Affairs, the Nuclear Contingency Organisation and the Radiological Contingency Organisation, all of them report to the Director General.

– Development and maintenance of human resources over the past three years

CNSNS currently has the following staff:

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General Organisation Structure	Number of Positions		
	2013	2015	Difference
Director General Office	7	10	+3
Deputy Directorate General of Nuclear Safety	46	54	+8
Deputy Directorate General of Radiation Safety	79	95	+16
Deputy Directorate General of Environmental Radiation Monitoring, Physical Security, and Safeguards	0	6	+6
Deputy Directorate General of Technology, Regulation, and Services	44	47	+3
Deputy Directorate General of Finance and Administration	37	41	+4
Internal Comptroller Office	5	5	0
TOTAL	218	258	+40

- Measures to develop and maintain competence

The basis of an effective regulatory programme is a well-founded safety culture, which is achieved mainly through a well-implemented management system and a training and education programme focused on the basic principles of safety.

CNSNS has implemented training programmes aimed at its personnel in order to ensure the acquisition of the appropriate skills, and the achievement and maintenance of adequate competence levels.

In order to achieve this objective, CNSNS relies on the following:

1.- General training about public service.

2.- Specialised technical training.

3.- An annual training programme.

Mexico, like most countries, is facing a generational lack of professionals trained in nuclear and radiation safety matters. Therefore, the people hired usually do not have enough knowledge or experience on these matters. In order to homologate the knowledge of graduates coming from different colleges and curricula, CNSNS has developed a basic

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training programme. This programme includes nuclear safety fundamentals, radiation safety fundamentals and an introduction to the areas and duties that are CNSNS's responsibilities.

Another action taken to develop and maintain the staff's competence is the personnel participation in training programmes of other regulatory bodies. Such is the case of the United States Nuclear Regulatory Commission (USNRC), which has provided training to CNSNS staff on Boiling Water Reactors (BWRs), among others, at the Technical Training Centre in Chattanooga, Tennessee, and at the Professional Development Centre in Bethesda, Maryland. Also, through international agreements, CNSNS's personnel have received training from organisations and centres in France, Germany, Argentina, Japan, Brazil, and the Philippines, among other countries. More recently, CNSNS also has benefitted from the European Commission's Nuclear Safety Cooperation Instrument (NSCI) created to foster a higher level of nuclear safety and radiation protection in third world countries.

During the period of this National Report, domestic training was received from several Mexican certified organisations, as well as from the International Atomic Energy Agency (IAEA), and regulatory bodies and Technical Support Organisations (TSO) of other countries. Most of the training received was on technical disciplines but some issues related to the public administration and organisational efficiency were also included. The training provided to CNSNS's staff exceeded, on average, 40 hours per year per person established by the Regulation of the "Law on Civil Service Career in the Federal Public Administration".

Also during this period, a strategy for institutional training was developed, and from it, a training methodology based on a systematic analysis of the training needed in order to develop and maintain the knowledge, skills and attitudes of CNSNS personnel. The plan is consistent with the methodology developed within the International Atomic Energy Agency (IAEA) and reflected in IAEA Safety Report Series No. 79, "Managing Regulatory Body Competence" and IAEA TECDOC 1757, "Methodology for the Systematic Assessment of the Regulatory Competence Needs (SARCoN) for Regulatory Bodies of Nuclear Installations." This effort has been undertaken for all CNSNS essential areas, with the advice of experts from a national university and the European Union.

– Developments with respect to financial resources over the pasts three years

The total budget assigned to CNSNS comes from the Mexican government. The allocation of financial resources in the last three years is shown below.

Year	Budget Mexican Pesos	Budget US Dollars
2013	139,327,423	8,077,561
2014	126,109,654	7,311,256
2015	174,731,933	10,130,151

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Because CNSNS is a deconcentrated body under the Secretariat of Energy, there is no income from its operation; since the fees paid by users of radioactive material for its licencing, handling and transportation, and the payment made by the Laguna Verde Nuclear Power Station (LVNPS) licence holder are collected directly by the Federal Treasury.

– Statement of adequacy of resources

The main challenges facing CNSNS are related to the financial and human resources available for its operation. The austerity policies established by the Federal Government have limited the financial resources for its operation. However, in recent years, CNSNS's budget has increased substantially because part of the fee paid by the LVNPP licence holder has been transferred to CNSNS. These additional resources have covered collaboration agreements with national and foreign research universities and institutions, as well as contracting private companies to complete projects, such as evaluation of various safety issues, strengthening of the management system, and the development of information systems to streamline internal processes.

In education, the postponement in recent decades of the global growth of nuclear power programmes has led to stagnation and even closing of some nuclear science and engineering programmes in Mexico. However, the same problem does not exist in other fields of engineering, including those covering the design, construction and operation of nuclear power plants. At CNSNS the combination of policies to reduce public spending and early-retirement programmes led to a substantial decrease in personnel early last decade. Although efforts have been made in the past decade to regain the human resources that CNSNS had in 2000, a period of knowledge lost from experienced personnel has been inevitable. Still, currently approximately 50% of the personnel in the areas of nuclear and radiation safety have an average of over 20 years of experience, in contrast to 3-5 years of experience for the personnel in other areas. The challenge for human resources at CNSNS is to establish a training and knowledge management programme that efficiently promotes the professional development of the new generation of regulators based on the knowledge and experience of senior staff.

– Quality management system of the regulatory body

CNSNS has an institution-wide Quality Assurance Plan since 1999.

In particular, in the area of nuclear regulation, a Quality Management System (QMS) has been developed and implemented, which is regularly updated. The QMS includes all the processes carried out to meet CNSNS's regulatory responsibilities regarding nuclear and radioactive installations. The QMS adopts the requirements of ISO 9001-2008 and its implementation is by way of the Quality Manual and the associated procedures and processes.

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In 2014 CNSNS obtained ISO 9001-2008 certification through the German certification company, TÜV Rheinland. The QMS certificate covers all substantive processes of CNSNS. The first verification visit, in 2015, verified that the certification is satisfactory.

- **Openness and transparency of regulatory activities including actions taken to improve transparency and communication with the public**

The Federal Law of "Transparency and Access to Public Government Information" which came into force on June 12, 2002, establishes guidelines for classifying government information, whether public, reserved or confidential. In order to support the compliance with this Law, the Federal Government created the web-based application INFOMEX, which is used by CNSNS to provide information to the public when requested.

- **External technical support**

Although CNSNS has qualified personnel in various technical areas, in some instances, consultants from the National Institute of Nuclear Research and national universities support some safety assessments.

The small budget increases in the last three years, have allowed CNSNS to carry out various projects to update its processes using information and communication technologies, in accordance with the Federal Government's policy. CNSNS has contracted external consulting services from private companies and national universities, which have provided support in this area.

The external consultants must provide a detailed written report. The report includes the bases and methods used for the assessment, the conclusions and any additional recommendation that may facilitate CNSNS's decision making process. Additionally, there is a contract clause that states that consultants shall keep independence from the LVNPS licence holder to avoid conflicts of interest.

- **Advisory committees**

Article 51 of the Nuclear Law states: *"The National Commission of Nuclear Safety and Safeguards will be headed by a Director General, and will have an Advisory Council and the staff necessary to perform its attributions."*

Likewise, Article 52 of the same Nuclear Law states: *"The Advisory Council's purpose is to advise the National Commission of Nuclear Safety and Safeguards. In order to achieve this goal the council will provide the technical support requested and perform the studies required to attend the consultations made by its President."* However, this Advisory Council has not been created yet.

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Article 8 (2) Status of the regulatory body

– Place of the regulatory body in the governmental structure

The structure of the Secretariat of Energy includes an office of the Undersecretary of Electricity. This office is responsible to support the whole operation of CNSNS, according to the Internal Regulations of the Secretariat of Energy.

It is the responsibility of the Secretariat of Energy to issue and update, through CNSNS, the appendixes, technical standards, manuals and instructions, needed to develop, make explicit and identify options to comply with the provisions of the General Regulation for Radiation Safety. CNSNS has the authority to interpret and apply this Regulation.

Figure 8.2 shows the position of CNSNS in the Federal Government organisation.

– Reporting obligations (to the parliament, government, specific ministries)

CNSNS is required to file a monthly progress report to the Secretariat of Finance and Public Credit (SHCP) about the compliance with the goals set up at the beginning of the fiscal year. It also has the obligation to provide the administration accountability annual report to the Secretariat of Energy. The report informs about the programmes executed and the results achieved by CNSNS's management.

– Means by which effective separation is ensured between the functions of the regulatory body and those of any other body or organisation concerned with the promotion or utilization of nuclear energy, and means by which independence of the regulatory body in making its safety-related decisions is assured

According to the provisions of the Nuclear Law, on January 26, 1979, the National Commission of Nuclear Safety and Safeguards was created as a deconcentrated body of the Secretariat of Energy. This Law empowers CNSNS as the responsible agency for all matters related to nuclear resources, control and surveillance of nuclear power production with maximum safety at nuclear installations. CNSNS is also responsible for assuring the adherence to the standards on nuclear and radiation safety, physical security, and safeguards. It should be noted that the Nuclear Law states that the Federal Executive Branch can also exercise these powers, through the Secretariat of Energy.

Moreover, Article 6, Fraction VII of the Secretariat of Energy Internal Regulations states that *"The Undersecretaries and the Chief Clerk have, within the scope of their jurisdiction, the power to coordinate the administrative units that are attributed and have besides the following abilities: Submit for the consideration of the Secretary, with the opinion of the Legal Affairs Unit, draft laws, regulations, decrees, accords, treaties, international*

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agreements and general legal provisions that contain provisions in the Secretary's area of competence;" In addition to this, Article 40 of the cited regulation establishes that *"CNSNS and the National Commission for the Efficient Use of Energy shall have the organisation and powers that establish the legal and regulatory laws for which they were created or that govern their organisation and operation".*

In the same fashion, Article 10, Sections I, XV, XXII and XXXII, states that: *"The Unit of the National Electric System and Nuclear Policy has the following powers: I. Contract with the Undersecretary of Energy on subjects relative to the National Electric System, Nuclear Policy, as well as those that are specifically assigned to them; XV. Start, process and resolve administrative proceedings and impose sanctions when applicable, in terms of the National Electric System, the laws and provisions related to it, and similar items related to the National Electric System and Nuclear Policy; XXII. Apply laws and other legal standards derived from these systems, the provisions of which are the responsibility of the Secretariat, to matters of nuclear energy; and XXXII. Develop and submit for consideration by the Undersecretary of Electricity, projects and programmes related to the nuclear industry and the use and development of nuclear energy and technology;"*

It should be noted that in the cited regulation, Article 42, among other abilities of the Director General of CNSNS, are the contents of Fractions VIII, X, XXV, and XXXI through XLIV, which state: *"Issue official Mexican standards, as well as preside and, if necessary, appoint correspondents to the President of the National Advisory Committees for Standardization; Participate, when appropriate, with the administrative units of the Secretariat in drafting applicable Mexican standards; Execute and monitor treaties and conventions related to nuclear and radiation safety, physical security, and safeguards, as well as international agreements, accords and commitments as referenced in the previous fraction; Issue and publish, in the Official Journal of the Federation, declarations related to the determination of what is considered nuclear fuel, source material, special fissionable material and radioactive mineral; Issue the standards that regulate the use of nuclear reactors and monitor compliance with them; Issue the regulations related to the storage, transport and disposal of nuclear fuel and radioactive waste; Issue the regulations in matters of nuclear and radiation safety, physical security, and safeguards, and monitor compliance; Issue, as appropriate and in accordance with applicable legal provisions, authorisation for the production, use and application of radioisotopes other than those produced from nuclear fuel; Collect and remove, if they exist, the instruments, equipment, material on-hand, and generally any movable contaminated items in nuclear installations; Enact the provisions related to energy- and non-energy-use of radioactive materials; Issue, as appropriate and in accordance with applicable legal provisions, authorisation for the handling and custody of radioactive materials; Authorise the appropriate public agencies to temporarily store nuclear fuel and radioactive waste derived from its use; Issue authorisation for the production of radioisotopes from nuclear fuel; Issue authorisation for the fabrication of components for nuclear steam supply systems; Issue authorisation for the handling, use , transport, storage, custody and reprocessing of nuclear fuel and materials; Grant, modify, suspend and revoke permits for conducting activities in nuclear installations, as well as grant licences to the*

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personnel that work in them; and Issue authorisation for the acquisition, import, export, possession, use, transfer, transport, storage, and final destination or disposal of radioactive material and ionizing radiation-generating devices, as well as for the import and export of nuclear fuel and materials."

Finally, it is important to note that the last paragraph of Article 50 of the Regulatory Law of Article 27 of the Constitution for Nuclear Material literally states that *"The Federal Executive, through the head of the Secretary of Energy, may also exercise the powers contained in the previous sections."*

Based on the above, it can be concluded that CNSNS is not administratively independent of the bodies responsible for promoting nuclear technology. Nevertheless, since its creation, CNSNS has been conducting all its affairs with complete technical independence.

– IRRS Mission information

CNSNS received two missions: IAEA International Regulatory Review Team (IRRT) in 2001, and IAEA Integrated Regulatory Review Service (IRRS) in 2007.

From both Missions the following recommendations have been made to CNSNS:

- Make more effort to obtain effective independence.
- Enhance the legal basis (completeness and consistency) and improve alignment with international standards and practices.
- Expand the nuclear regulatory framework and develop an enforcement policy.
- Establish mechanisms for an independent communication with the public on the regulatory requirements, decisions, opinions and its bases.
- Enhance the internal working procedures related to the establishment of priorities, the coordination of activities and the allocation of resources
- Enhance the effectiveness of the inspection and evaluation processes
- Integrate a training programme for CNSNS's staff with special attention to inspector training
- Develop the legal mechanisms to ensure sufficient financial resources.

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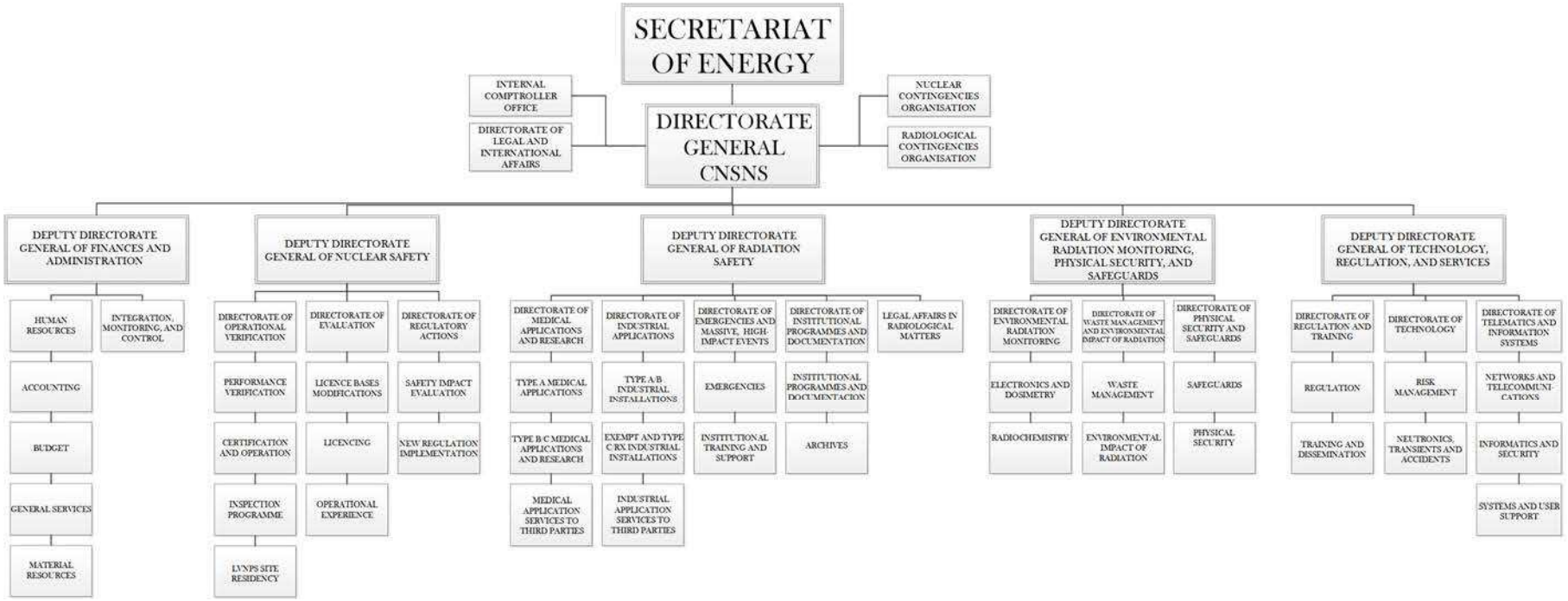

FIGURE 8.1 NATIONAL COMMISSION FOR NUCLEAR SAFETY AND SAFEGUARDS (CNSNS) ORGANISATION CHART

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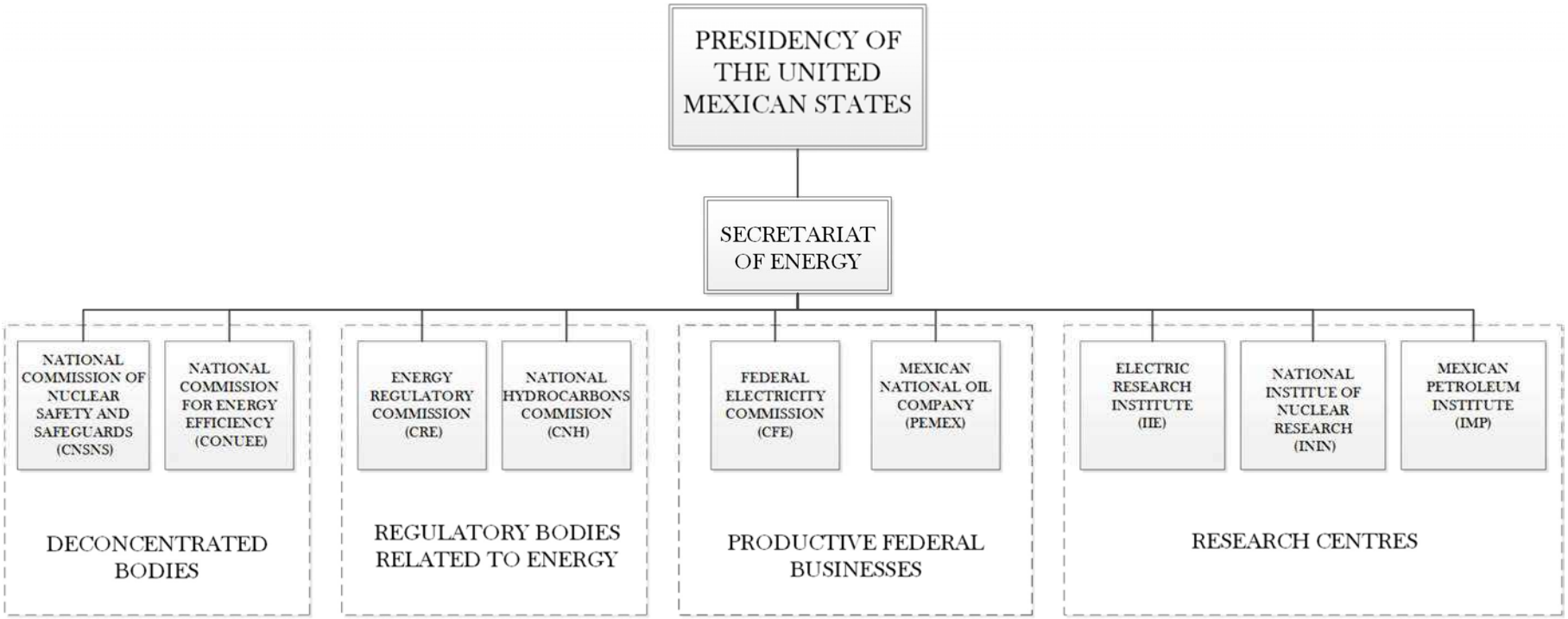

FIGURE 8.2 POSITION OF CNSNS IN THE FEDERAL GOVERNMENT ORGANISATION

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ARTICLE 9. RESPONSIBILITY OF THE LICENCE HOLDER

Obligations

"Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the licence holder and shall take the appropriate steps to ensure that each such licence holder meets its responsibility."

- **Formulation in the legislation (quotation) assigning the prime responsibility for safety to the licence holder**

The Regulatory Law on Nuclear Matters of Article 27 of the Constitution (hereinafter called "Nuclear Law") states in its Article 27 that *"The nuclear installations shall be staffed with the nuclear and radiation safety personnel required, and the head of the corresponding government agency shall be responsible for the strict compliance with applicable standards."*

Likewise, the Law of Public Liability for Nuclear Damages that entered into effect on December 29, 1974, provides in its Article 4 that *"The operator's public liability for nuclear damages is objective"*; that is, the operator of the nuclear installation is responsible for potential damages that might be caused by the installation.

- **Description of the main means by which the licence holder discharges the prime responsibility for safety**

The nuclear safety of Laguna Verde Nuclear Power Station (LVNPS) Units 1 and 2 is the Federal Electricity Commission's (CFE) responsibility, through the Nuclear Power Plant Division, as accepted and observed in his Quality Assurance Plan. According to this plan, CFE's General Director keeps the obligation before CNSNS for conducting a safe operation and design changes of the LVNPS Units 1 and 2, according to the guidelines established in the regulatory framework, Operation Licence, Technical Specifications (TS) and Quality Assurance Plan.

- **Description of the mechanism by which the regulatory body ensures that the licence holder discharges its prime responsibility for safety**

The main responsibilities defined by CNSNS to be met by the Federal Electricity Commission, operator of LVNPS, are stipulated in the Operation Licence Terms and Conditions of each of the units.

CNSNS has also established several mechanisms to guarantee that the licence holder satisfies each one of the items related to the obligations acquired through the licence. These mechanisms include the following:

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1. Establish a Baseline Inspection Programme;
2. Evaluate the design changes classified as safety significant
3. Independent analysis of operating events and their safety significance. Follow up to the safety improvements arisen from the application of the operational experience
4. Performance evaluation in nuclear safety
5. Laws and regulation for enforcement in nuclear matter

As indicated in Articles 8 and 14, the Baseline Inspection Programme is aimed to collect enough information about the performance of nuclear installations and the licence holder's activities. This allows determining along with the Performance Indicators, when appropriate, if the licence holder is meeting the safety objectives, and identify performance issues to enable the regulatory body to follow-up and take actions before safety is compromised. The inspection frequency depends on the type of activity and its significance for the installation's safety. The Baseline Inspection Programme indicates the minimum number of scheduled inspections to be performed during the period in which the installation performance has a "response from the installation" status. Additionally, the Baseline Inspection Programme includes some inspections to verify the following:

1. Quality-related areas;
2. Supervising groups; and
3. Cross-cutting elements which are programmed with a biennial frequency.

Additional information about the functions and responsibilities of CNSNS, as well as specific activities to verify that the LVNPS meets its responsibilities for safety are presented in Articles 8 and 14.

- **Description of the mechanism whereby the licence holder maintains open and transparent communication with the public**

Through the annual broadcast programme, Emergency External Radiation Plan, to the communities surrounding LVNPS, the management of CFE's nuclear centres maintain open and transparent communication with the public, providing them with the necessary information required to implement said plan. They have formed an additional method for informing the public about nuclear technology by providing guided visits of the centre.

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– **Description of the mechanism by which the Contracting Party ensures that the licence holder of the nuclear installation has appropriate resources (technical, human, financial) and powers for the effective on-site management of an accident and mitigation of its consequences**

The budget allotted to CFE, specifically for LVNPS, is approved by the Chamber of Deputies. It is developed under a set of rules and procedures contained in the budget regulations.

The budget process covers the entire range of planning and formulation, review and approval, spending control and audit. Due to LVNPS's technology, it is obligated to comply with various safety standards, including among them the Technical Operating Specifications that ensure the safe and reliable operation of LVNPS. For this reason, the budget planning process for LVNPS focuses on the maintenance of safety-related equipment, as well as the acquisition of goods and services that guarantee the same.

As the executor of spending, LVNPS has the autonomy to implement budgetary processes and assign them to issues that affect or ensure safety, always in compliance with applicable regulations. In addition, the Federal Law of Budget and Fiscal Responsibility, in Article 46, considers that one can solicit the Secretariat of Finance and Public Credit for resources to meet contingencies, or where applicable, urgent operating expenses.

Additionally, CFE has a Comprehensive Insurance Programme, which is updated annually. This programme consists of nine policies:

1. Comprehensive Policy
2. Policy for Various Property Risks
3. Policy for Physical Damage to LVNPS
4. Policy for LVNPS's Civil Responsibility
5. Policy of Responsibility for Non-Physical Damage
6. Maritime and Cargo Transport Policy
7. Aircraft Policy
8. Vehicle Fleet Policy
9. Heavy Mobile Equipment Policy

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ARTICLE 10. PRIORITY TO SAFETY

Obligations

"Each Contracting Party shall take the appropriate steps to ensure that all organisations engaged in activities directly related to nuclear installations shall establish policies that give due priority to nuclear safety."

– Overview of the Contracting Party's arrangements and regulatory requirements regarding policies and programmes to be used by the licence holder to prioritise safety in activities for design, construction and operation of nuclear installations

▪ Description of the agreements and regulatory requirements

Regarding the agreements and regulatory requirements to give priority to safety, Articles 19, 20, 21, 28, 32, 34, and 50 of the Regulatory Law on Nuclear Matters of Article 27 of the Constitution establishes that of all installation activities performed by the licence holder, including planning, design, construction and operation as well as definitive shutdown and decommissioning, safety always has the highest level of importance.

▪ Safety policies

Laguna Verde Nuclear Power Station's (LVNPS) safety policy is shown in Figure 10.1 and it is based on the principles for a strong nuclear safety culture from Institute of Nuclear Power Operations' (INPO) document of November, 2004. The principles and associated attributes described are soundly based on significant events of the nuclear industry. These principles and attributes are connected with, and influence, the values of: ownership, experiences, behaviours, beliefs and models of LVNPS's staff.

LVNPS Top Management is committed to the principles and policies for its daily duties. Any difference or deviation is used as a basis for improvement.

▪ Safety culture programmes and development

The Safety Culture (SC) programme includes the following activities:

- Establishment of the Safety Culture Policy.
- Establishment of programmes and guidelines for the control of the Safety Culture Program.
- Development of promotional material.

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- Daily reinforcement of the Features of a Healthy Culture of Nuclear Safety (FHCNS) conducted by the organisation's leaders:
  - Presentation in the supervisors meetings.
  - Presentation by supervisors in workshops.
  - Promotion via electronic mail to all members of the organisation.
- SC self-assessment program following the guidelines provided by IAEA during Safety Culture seminars, under the "Enhancing Nuclear Power Plant Life Management and Safety Culture Practices in Latin America" project (RLA9080).
  - Surveys (annual).
  - Interviews (triennial).
  - Focus groups (triennial).
  - Documental review (triennial).
  - Field observations (continuous).
- Feedback to staff about the results of the SC self-assessment.
- Establishment of a continuous-improvement program based on the SC self-assessments.
- Evaluation of the FHCNS involved in CFE's nuclear power plant division (NPPD) events that require a root cause analysis.
- Daily monitoring of conditions or indications not clearly addressed in the leaders meetings, resulting from the re-assessment of SOER 2003-02 "Davis-Besse Reactor Vessel Head Degradation".

In addition to the Safety Culture programme, LVNPS has implemented a set of essential processes, which were developed to create a sustainable framework for Safety Culture. The SC framework is shown in Figure 10.2. The Safety Culture pyramid described in this Figure is constructed with the regulatory framework and the processes for continuous performance improvement.

The development of the processes for continuous performance improvement consists of the following:

1. The Safety Culture is an integral part of the Policies, Vision and Mission of the NPPD.
2. Extensive on-site communication.
3. Observation programmes.
4. Continuous learning organisation.
5. Monitoring the Safety Culture process.

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6. Management process.
7. Process of effective and conservative decision-making.
8. Process for determining the operability of systems and components.
9. Systematic Approach to Training (SAT).
10. Housekeeping and materials conditions.
11. International agreements.

- **Arrangements for safety management**

LVNPS voluntarily established policies and the Safety Culture Manual, which are monitored through the implementation of continuous improvement processes, and the plant's Safety Culture programme development and support.

- **Arrangements for safety monitoring and self-assessment**

LVNPS is developing Performance Indicators according to the requirements established in the Nuclear Reactor Monitoring System (NEI 99-02 Rev. 6), in order to compare LVNPS performance with similar plants and emulate the best international practices. As an example, in Figure 10.3 the results for the fourth quarter of 2015 are displayed. Performance Indicators for radiation protection, industrial safety and environmental protection have also been developed.

The self-assessment process is being used by LVNPS's groups to identify opportunities for improvement. The process has improved significantly, both in quantity and quality of self-assessments. In 2015, 108 self-assessments were conducted both in LVNPS and the attention areas of industry. 71 Condition Reports, resulting from the self-assessments have also been documented, and 122 corrective actions have been implemented to correct the problems encountered. Additionally, in order to strengthen the Safety Culture and evaluate the improvements, an annual assessment is performed using the eight principles of INPO/World Association of Nuclear Operators (WANO). The results from these evaluations are presented in Figure 10.4.

- **Independent safety assessments**

Currently, LVNPS is subject to two types of external assessments.

a) The first one, in compliance with the Operation Licence and in accordance with the Technical Specifications (TS) requirement, is an independent inspection to the fire protection and loss prevention system, which is performed at least every 12 months.

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These inspections can be performed by Federal Electricity Commission's (CFE) qualified personnel, external inspectors or by staff of a company specialized in fire protection or quality assurance. If CFE's qualified personnel are chosen, then at least every three years the inspection and the audit must be performed by staff of a company specialized in the topics mentioned above.

b) The second type corresponds to external assessments that go beyond regulatory requirements, such as International Atomic Energy Agency (IAEA) Assessment of Safety Significant Events Team (ASSET), Operational Safety Assessment Review Team (OSART) and Safety Culture Assessment Review Team (SCART) missions, as well as peer or counterpart reviews, carried out by WANO, because LVNPS is a Level 3 member of this association since 1997.

Table 10.1 presents the external assessments conducted from 1997 to December 2015.

Assessment	Date
WANO (Peer review)	November 1999
TUV ANLAGENTECHNIK (Independent audit)	November 2000 to January 2001
WANO (Peer review)	December 2002
WANO (Peer review)	December 2004
WANO (Peer review)	September 2006
WANO (Peer review)	February 2009
SCART	November 2009
WANO (Peer review)	May 2011
OSART	October 2012
WANO (Peer review)	October 2013
Independent evaluation of the Safety Culture (by HPA)	February – March 2015
WANO (Peer review)	October 2015

Table 10.1 LVNPS external assessments

In February 2009, a WANO Atlanta Centre peer review was conducted at LVNPS. The areas of Operation, Maintenance, Engineering, Chemistry, Training, Industrial Safety, Radiation Protection, Planning, Operational Experience, Organisational Effectiveness, etc. were reviewed. The review lasted three weeks, one week for documental review and two weeks for on-site review through interviews, jobs observation and documental review.

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In October 2009, LVNPS received an IAEA SCART mission for the first time, with satisfactory results. The final report issued highlights the robust Safety Culture found in the plant which was evident through interviews with workers, their performance as well as the processes of all the groups.

In May 2011 a WANO Atlanta Centre peer review was conducted at LVNPS. The review included the same areas covered in 2009, and for the first time the Fire Protection programme was included.

In October 2012, LVNPS received an IAEA OSART mission, the first review of its kind in more than 15 years. From this mission, a set of recommendations were issued for the following areas:

- Administration and Organisation Management
- Operation
- Maintenance
- Technical support
- Operational Experience
- Radiation Protection
- Chemistry
- Preparedness and Plans Emergency
- Severe accident management

Again in October 2013, a peer review assessment was carried out by WANO Atlanta Centre, the purpose of which was to evaluate the LVNPS's functional areas, as well as the entire organisation, in order to define the strengths and areas for improvement, based on the high standards of the nuclear industry.

In 2015, Human Performance Analysis (HPA) was contracted to carry out an independent evaluation of the Safety Culture and to obtain a descriptive evaluation of the culture of the NPPD, indicating the basic assumptions that govern the culture.

Also in 2015 a group of 20 Safety Culture Ambassadors was formed with the support of the IAEA under project RLA9080. This multidisciplinary team will be responsible for safety culture self-assessments, and to provide support to the organisation to implement the improvement activities needed to positively influence the culture of the NPPD.

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- **Discussion on measures to improve safety culture**

LVNPS is the first Latin American centre to implement the IAEA's Safety Culture Continuous Improvement Process (SCCIP), under RLA9080.

With safety performance a priority, the evaluation and understanding of the safety culture at the nuclear power plants are key elements to identify and prevent vulnerabilities that can lead to a decrease in safety performance, as well as production performance.

The process of continually improving safety culture contributes to strengthening and improving the safety culture of the entire organisation. The process consists of five steps:

1. Workshop on safety culture for managers, the purpose of which is to show how the culture influences the safety performance, and to understand that a culture change requires a big effort, more so in the managers than in the rest of the organisation.
2. Theoretical and practical training of a team called the Safety Culture Ambassadors, whose purpose is to perform self-assessments of the safety culture and to promote change in the safety culture.
3. Complete a self-assessment of the safety culture with the purpose of obtaining a diagnostic of the organisation that helps define improvement actions.
4. Dissemination of results and feedback from the organisation in order to finalize the report.
5. Implement the improvement actions.

After working through the entire process, steps 3, 4 and 5 will periodically be repeated in the NPPD (every three years) in order to achieve continuous improvement of the safety culture and to contribute to the safety performance of the plant.

On top of all this, LVNPS has incorporated the practices described in NEI 09-07 Rev. 1, "Fostering a Healthy Nuclear Safety Culture," providing the continuous monitoring described in the IAEA model, permitting closer monitoring of behaviour and prompt course correction if the desired results are not being obtained. Following the NEI 09-07 model, the Safety Culture Ambassadors meet twice a year with a panel of NPPD directors to provide them feedback on the safety culture and so they may reinforce positive actions and redirect (correct) others.

- **Process-oriented (quality) management system**

LVNPS developed a Quality Management System (QMS), which consists of a set of documents such as: the quality policy, the organisation manual, quality management manual, work procedures, quality records, and training programmes.

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The QMS has been certified by a company accredited in International Quality Certifications by the Mexican Accreditation Authority (EMA) and audited internally according to the following standards: (1) ISO 9001:2008 "Quality Management Systems", (2) ISO 14001:2004 "Environmental Protection Management System", and (3) NMX-SAST-001-2008 "Occupational Health and Safety."

- **Measures taken by the licence holder to implement arrangements for the priority of safety, such as those above and any other voluntary activities and good practices, examples of Good Practices and safety culture achievements**

The actions and good practices that CFE's NPPD has implemented to improve the Safety Culture in its organisation are listed below.

1. Workshops on Safety Culture

The object of these workshops is to reinforce the values to maintain an organisational Safety Culture through the following:

a) Stressing a high respect for nuclear technology.

b) Increasing awareness, understanding and applying the Defence in Depth (DID) concept.

c) Encouraging the development and implementation of Good Practices for work and operation.

2. Safety Culture Monitoring Process

SGO-CS-002 "Safety Culture Monitoring Guideline" contains the basis for the monitoring process of the LVNPS's SC health. The monitoring process is shown in Figure 10.5 and works as follows:

The Nuclear Safety Culture Monitoring Panel (NSCMP) watches the process inputs which are indicative of the organisation's SC health to identify strengths and potential problems that deserve further attention by the organisation.

The NSCMP is composed of professionals from plant´s strategic areas with backgrounds in nuclear technology. The group, through its chairman, informs the Onsite Leadership Team. The panel members include experienced professionals with responsibilities in the process inputs. (For example, Corrective Action Programme or CAP, self-assessments, regulatory compliance and nuclear safety surveillance).

The NSCMP has two major functions:

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- Review arising situations that can impact the nuclear safety culture and ensure proper attention is paid to them; and
- Periodically, at least every four months, assess trends or potential problems, and prepare a report for the Onsite Leadership Team. The Independent Committee of Human Performance (ICHP) has this responsibility. The report contains the trends and potential situations in the process inputs that can indicate problems related to nuclear safety culture.

The Onsite Leadership Team shall review the nuclear safety culture self-assessment reports prepared by the NSCMP before they meet. The final result will be a better understanding by each Onsite Leadership Team member about the efforts required to improve LVNPS's nuclear safety culture. Follow-up actions shall be generated for the opportunity areas identified during the Onsite Leadership Team review. These actions must be communicated to the plant personnel to align the desired behaviour and strengthen the nuclear safety culture.

3. *Safety Culture Self-Assessment Process*

SGO-CS-002 "Safety Culture Monitoring Guideline" contains guidelines for the self-assessment process of the plant's SC health, which is based on the Utilities Service Alliance's "Nuclear Safety Culture Assessment Process Manual" from the United States. This assessment process uses INPO´s principles for a strong nuclear safety culture. Thus the NPPD's nuclear safety culture assessment is performed in terms of INPO's principles and attributes, which are an integral part of LVNPS's Safety Culture Policy. The assessment uses surveys, interviews, and observations. The assessment report provides strengths, observations, weaknesses and recommendations for action.

4. *Safety Culture Performance Indicators*

The Performance Indicators directly related to the Safety Culture are shared via the NPPD's intranet with all CFE personnel. Currently, CFE, with IAEA assistance, is complementing this set of indicators with others to show more directly the aspects of safety culture. The NPPD procedure "Safety Performance Indicators" is applied for this activity.

5. *Assessment of LVNPS staff perceptions on Safety Culture*

The surveys that CFE has conducted since 1998, changed in 2000 and 2006. In these instances, a brief questionnaire to measure the level of staff awareness regarding LVNPS Safety Culture was used. The most recent change was made in 2012 to update the survey according to the Utilities Service Alliance's "Nuclear Safety Culture Assessment Process Manual" (also cited in point 3 above), which provides guidelines for the Safety

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Culture self-assessment process in the USA. The new survey enables an objective comparison of the results, which allows reorienting the allocation of resources to the areas that need improvement, and provides the means to verify the effectiveness of the actions taken.

6. *Implementation and continuous improvement of Safety Culture*

Several relevant actions have been implemented to provide continuous improvement on Safety Culture issues, as described previously in the "Licence holder safety culture programmes and development" section of this article.

- **Regulatory processes for monitoring and oversight of arrangements used by the licence holder to prioritise safety**

CNSNS evaluates the mechanisms used by LVNPS to give priority to safety. To this end, the recommendations established by the IAEA (TECDOC-369 "Management for Excellence in Nuclear Power Plant Performance") are followed to determine through the analysis of the inspection reports that:

1. There is an effective appointment of responsibility and authority.
2. There is the ability to anticipate, identify and correct problems.
3. A culture of quality is achieved and maintained.
4. The use of key resources is optimised.
5. There is a proper interface between organisations.
6. There is the ability to focus on long-term performance.

Every three months, CNSNS holds a meeting with LVNPS to inform it about any weaknesses detected in the attributes listed above, with the objective that weakness be properly addressed.

- **Means used by the regulatory body to prioritise safety in its own activities**

CNSNS considers that Probabilistic Safety Analysis (PSA) technology should be applied in all regulatory activities where it is technically feasible, considering the state of the art of PSA methods and data to complement the deterministic regulatory approach and support Defence in Depth philosophy.

This position is aimed to increase the regulatory process efficiency and effectiveness by incorporating risk-based information to achieve comprehensive decision-making, in order to reduce unnecessary burdens on the licence holder. This approach also facilitates the

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allocation of CNSNS and license holder's resources and efforts on the most safety significant issues.

In this regard, some of the mechanisms used by CNSNS to give priority to safety in their own activities are: 1) the analysis and consideration of changes to regulations, regulatory guidelines, licencing requirements, inspection programmes and regulatory practices; 2) commitment on the allocation of resources that takes into account the importance to safety; 3) take the appropriate actions to train CNSNS´s staff to develop the needed skills to perform their activities; 4) commitment to maintain and improve the licenced installation safety level, as well as an open and easy communication with the licence holder.

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CFE
COMISIÓN FEDERAL DE ELECTRICIDAD

GERENCIA DE CENTRALES NUCLEOELÉCTRICAS
CENTRAL LAGUNA VERDE

POLÍTICA DE CULTURA DE SEGURIDAD

Cultura de Seguridad es el comportamiento y los valores de una organización (modelada por sus líderes e interiorizado por sus miembros) que sirven para hacer que **la prioridad en la seguridad nuclear esté por encima de la Producción y Presupuesto.**

Todos los que laboramos en la GCN consideramos a la **SEGURIDAD como la mayor prioridad**, tomando decisiones conservadoras y eficaces, aplicando las herramientas para prevención de errores humanos, el uso y apego a procedimientos, así como valorando el aprendizaje continuo y fomentando un ambiente de trabajo conscientes de la SEGURIDAD, manifestando una actitud cuestionadora sin temor a represalias. Las decisiones y acciones se basan en esta prioridad y le damos seguimiento para verificar que los problemas relacionados con la seguridad nuclear reciban la atención apropiada. El ambiente de trabajo, nuestras actitudes y comportamientos, así como las políticas, entrenamiento y procedimientos fomentan esta cultura.

De igual manera participamos activamente en el plan de emergencia radiológica de acuerdo con las actividades que tenemos asignadas en etapa de preparación (verificación, calibración y mantenimiento de equipos, pruebas, compras de equipos y materiales, revisión de procedimientos) y en estar listos en caso de respuesta a una emergencia real, por lo que debemos participar en entrenamiento, simulacros, prácticas y en la retroalimentación de las tareas que tengamos asignadas en la respuesta.

Debemos asegurar que en nuestras actividades se evidencie la presencia de los rasgos para una sana
CULTURA DE SEGURIDAD NUCLEAR

- Responsabilidad personal por la seguridad.
- Actitud cuestionadora.
- Comunicación de seguridad eficaz
- Liderazgo con acciones y valor por la seguridad.
- Toma de decisiones.
- Ambiente de trabajo respetuoso.
- Aprendizaje continuo
- Identificación y solución de problemas
- Ambiente para plantear inquietudes
- Procesos de trabajo.

ING. AGUSTÍN LOZANO LAEZ
GERENTE DE CENTRALES NUCLEOELÉCTRICAS

FEBRERO 2014

FIGURE 10.1 CFE'S NUCLEAR POWER PLANT DIVISION'S SAFETY CULTURE

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FIGURE 10.1 (Translation to English)

Nuclear Power Plant Division
Safety Culture Policy

Safety culture is the organisation's behaviour and values (modelled by its leaders and internalized by all its members) that place priority on nuclear safety, above Production and Budget.

All of us, the employees that work in CFE's Nuclear Power Plant Division consider **SAFETY** the top priority, making conservative and efficient decisions, applying human error prevention tools, using and adhering to procedures, valuing continuous learning, and fostering a **SAFETY** conscious work environment, manifesting a questioning attitude without fear of retaliation. These decisions and actions are based on this priority, and they are followed-up to verify that nuclear safety-related problems receive due attention. The work environment, our attitudes and behaviours, as well as the policies, training and procedures foster this culture.

We will actively participate in the radiological emergency plan, performing the activities assigned for the preparation stage (verification, calibration, and maintenance of equipment; tests; purchase of equipment and materials; review of procedures), and in order to be ready in the case of a real emergency, we must participate in training, simulations, drills, and the subsequent feedback process.

We must ensure that our actions demonstrate the features of a healthy NUCLEAR SAFETY CULTURE

- Personal responsibility for safety.
- Questioning attitude.
- Effective communication about safety.
- Leadership with safety-focused actions and values.
- Decision making.
- Respectful work environment.
- Continuous learning.
- Identifying and solving problems.
- Environment supporting the raising of concerns.
- Work processes.

AUGUSTIN LOZANO LAEZ, B.S.
MANAGER OF CFE´s NUCLEAR POWER PLANT DIVISION
February 2014

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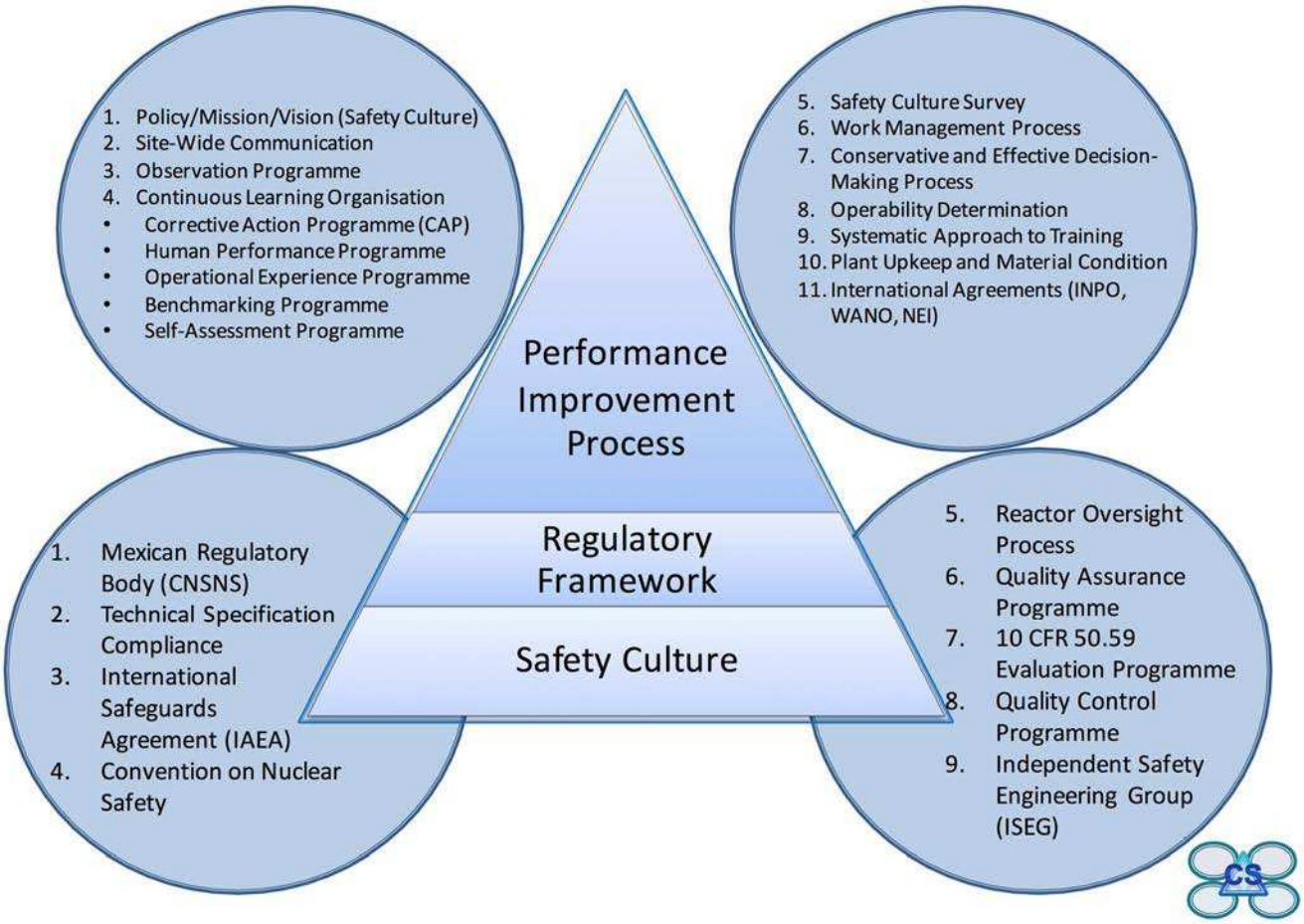

FIGURE 10.2 FRAMEWORK OF LVNPS'S SAFETY CULTURE

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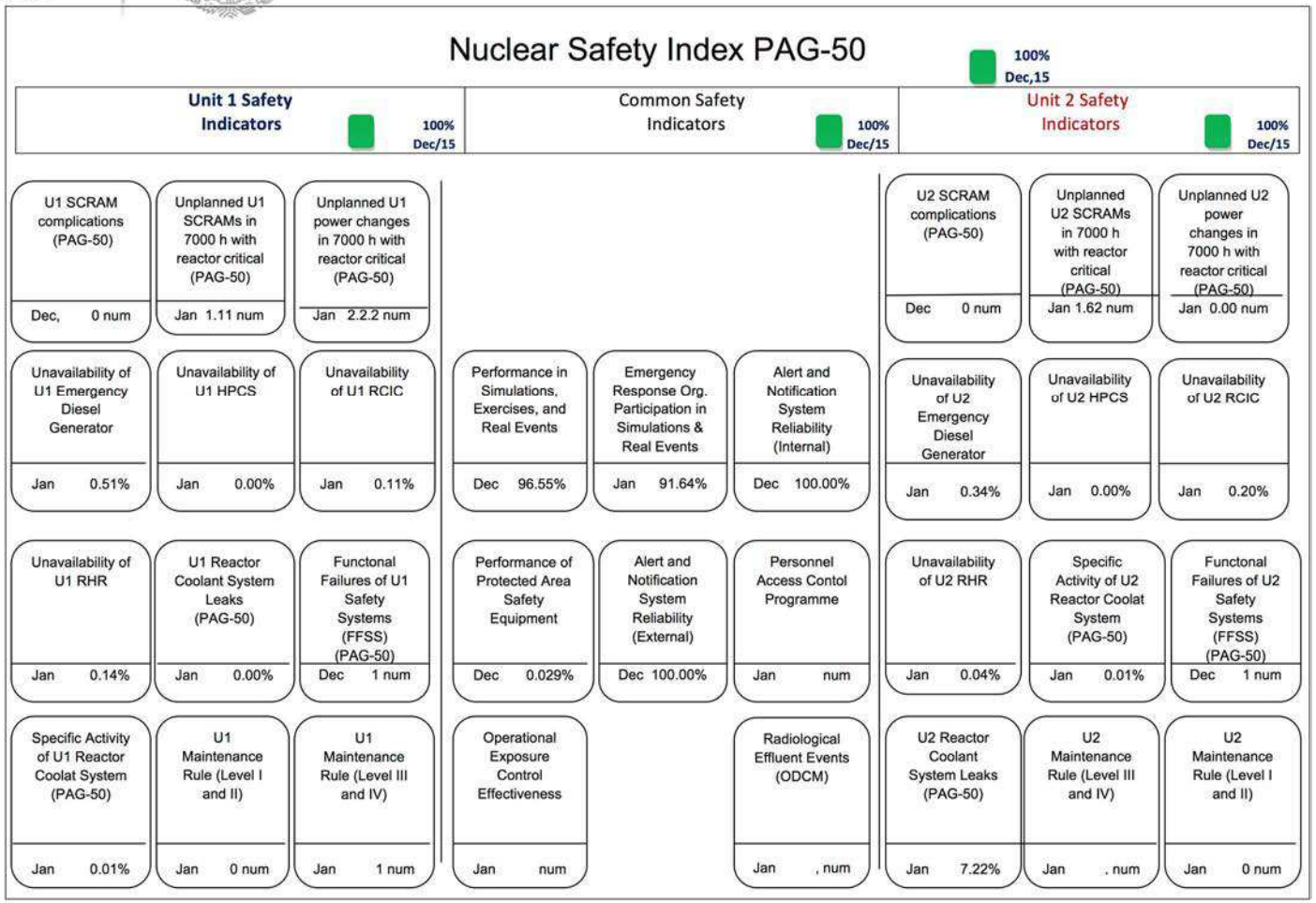

FIGURE 10.3 PERFORMANCE RATING DISPLAY BASED ON PERFORMANCE INDICATORS

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	Adm	Eng	Maint	Prod	Safe	Serv	Oper	Coord	Train	Aut	Mgmt
Feature 1	96.38%	95.38 %	96.33 %	95.93 %	96.46 %	96.64 %	95.08 %	95.98 %	96.81%	97.14 %	97.48 %
Feature 2	80.14%	89.49 %	92.05 %	89.14 %	91.52 %	91.29 %	87.87 %	90.53 %	93.25%	90.93 %	93.65 %
Feature 3	88.44%	87.82 %	89.53 %	81.21 %	87.78 %	88.70 %	80.09 %	83.24 %	91.86%	86.88 %	93.27 %
Feature 4	87.18%	87.87 %	86.77 %	79.99 %	86.68 %	86.93 %	80.05 %	87.12 %	89.00%	87.04 %	91.96 %
Feature 5	89.32%	89.74 %	88.98 %	83.52 %	88.66 %	88.95 %	82.84 %	90.83 %	90.39%	89.17 %	92.98 %
Feature 6	78.21%	78.55 %	79.90 %	73.81 %	77.73 %	79.27 %	75.52 %	78.61 %	82.40%	78.33 %	81.43 %
Feature 7	89.80%	86.53 %	88.82 %	81.16 %	88.95 %	90.06 %	82.85 %	90.00 %	91.63%	87.22 %	93.49 %
Feature 8	85.10%	84.73 %	84.25 %	76.84 %	84.86 %	84.95 %	76.88 %	83.02 %	85.82%	83.33 %	89.64 %
Feature 9	87.41%	86.42 %	85.25 %	83.03 %	87.28 %	87.63 %	83.69 %	88.15 %	88.92%	92.92 %	90.71 %
Feature 10	87.99%	88.36 %	89.22 %	85.71 %	90.00 %	89.36 %	84.84 %	90.79 %	90.59%	85.48 %	92.59 %
Average	87.00%	87.49 %	88.11 %	83.04 %	87.99 %	88.38 %	82.97 %	87.83 %	90.07%	87.84 %	91.72 %

FEATURES OF A HEALTHY NUCLEAR SAFETY CULTURE

Personal Commitment to Safety		Management Commitment to Safety		Processes Focused on Safety	
1	Personal responsibility for safety	4	Leadership with safety-related actions and values	7	Continuous learning
2	Questioning attitude	5	Decision making	8	Identification and solution of problems
3	Effective safety communication	6	Respectful work environment	9	Environment to raise concerns
				10	Work processes

EVALUATION CRITERIA

RANGES	EVALUATION	COLOR
85 % ≤ X< 100 %	VERY GOOD	GREEN
75 % ≤ X < 85 %	GOOD	WHITE
65 % ≤ X < 75 %	SATISFACTORY	YELLOW
1 % ≤ X < 65 %	NOT SATISFACTORY	RED

FIGURE 10.4 ANNUAL SURVEY ON SAFETY CULTURE

- The table presents the results after processing the responses of all LVNPS personnel.
- Assessment of the questionnaire as the average of all areas of CFE's Nuclear Power Plant's Division in 2015 indicate that the Safety Culture is "Very Good" (85% - 100%) in 7 principles and "Good" (75% - 85%) in the other 3 principles (Respectful work environment, Identification and solution of problems, and Environment to raise concerns).

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Where:

Abbreviation	Department
Adm	Administration
Eng	Engineering
Maint	Maintenance
Prod	Production
Safe	Nuclear Safety
Serv	Services
Oper	General Operations
Coord	Coordination and Liaison
Train	Training
Aut	Autonomous
Mgmt	Management

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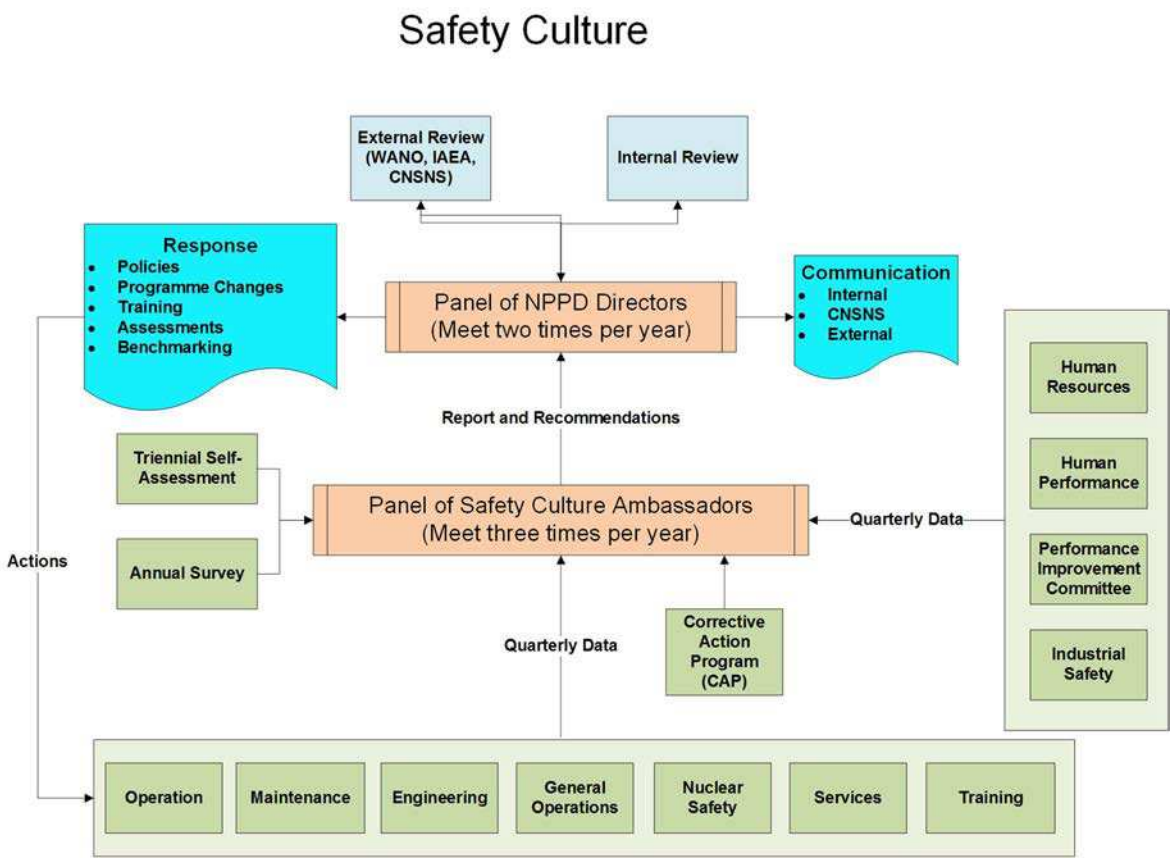

FIGURE 10.5 LVNPS NUCLEAR SAFETY CULTURE MONITORING PROCESS

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ARTICLE 11. FINANCIAL AND HUMAN RESOURCES

Obligations

1. *"Each Contracting Party shall take the appropriate steps to ensure that adequate financial resources are available to support the safety of each nuclear installation throughout its lifetime."*

2. *"Each Contracting Party shall take the appropriate steps to ensure that sufficient numbers of qualified personnel with appropriate education, training and retraining, are available for all safety-related activities in or for each nuclear installation throughout its lifetime."*

Article 11 (1) Financial Resources

- **Mechanisms for the provision of financial resources to the licence holder or applicant in order to ensure safety of the nuclear installation throughout its lifetime**

- **Principles for the financing of safety improvements to the nuclear installation over its operational lifetime**

Financial resources to assure a safe and reliable operation and maintenance of Laguna Verde Nuclear Power Station (LVNPS) come from the Federal Government. They are requested via the application for authorisation of the budget as part of the strategic and operative programmes.

The Operation and Maintenance expenditures are privileged at LVNPS as compared to the rest of CFE facilities; since the requirements of the Mexican Regulatory Body must be met to maintain compliance with the Operation Licence of both generation units.

The management process of the financial resources contributes to meeting the plant safety standards during normal operation, refuelling outages and major maintenance programmes.

The improvements, additions and replacements of main structures, systems and components of the production-related buildings are considered in a business plan, supported by the strategic objectives, and have the ultimate goal of ensuring their reliability. The financial resources management for improvements is based on a cost benefit analysis whenever it is proved that the investment will bring added value and be profitable.

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- **Principles for financial provisions during the period of commercial operation for decommissioning and management of spent fuel and radioactive waste from nuclear installations**

The costs for decommissioning, and handling and disposal of radioactive waste from LVNPS at the end of its lifetime are booked and appear in the financial statements. This provision is calculated based on the legal requirement jointly issued by LVNPS and CFE's corporate accountant, where it indicates that LVNPS will integrate a fund of 1,275.3817 million dollars US (in 2012) for both units, in accordance with the methodology established by the USNRC in 10 CFR Part 50.75, with data from NUREG 1307 Rev. 15. This amount will be periodically updated based on data issued in new revisions of NUREG 1307. This fund will be integrated into the production costs for future storage of radioactive waste and decommissioning.

LVNPS has chosen a method of decommissioning in which the nuclear installation is placed and maintained in a condition that allows the facility to be safely stored and subsequently decontaminated (SAFSTOR), in accordance with the provisions of NUREG/CR-6174. The method has five stages of work:

a) Planning, regulatory assessment, engineering and preparation for final reactor shutdown.

b) Ceasing plant operation and preparing for decommissioning.

c) Safe removal of spent fuel from Reactor Pressure Vessel, and storing it in the fuel pool (5 to 6 years).

d) Extended period for fuel safe storage (approximately 60 years).

e) Decontamination and dismantling at the end of the licence period for decommissioning (60 years).

As part of the extended period for safe storage of spent fuel, there is the following:

Prior to the end of useful life of LVNPS's independent spent fuel storage installation (ISFSI), HOLTEC International, Inc.'s multipurpose canisters (MPC), loaded with spent fuel, will be transferred to its packaging, called HI-STORM FW, to a transport container, called HI-STAR, for transportation off-site, to an approved final disposal site.

Because the MPC canisters are designed for storage, transport and disposal of spent fuel, the fuel cells will remain sealed inside the canisters, so decontamination of the MPC canisters is not required for transportation to the final repository.

After the transfer off-site of the MPC canisters, the ISFSI can be dismantled, identifying and removing the radioactive waste, and creating a final radiological report.

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CFE will evaluate and modify the existing analysis of the dismantling of LVNPS Units 1 and 2 to include the financing cost of dismantling the ISFSI.

- **Statement with regard to the adequacy of financial provisions**

Financial resources for the safe and reliable operation of LVNPS are assured within their own annually authorised budget. Furthermore, laws take into account additional resources to respond to contingencies and/or urgent expenses.

LVNPS includes within its own budget annual financial resources for recruiting, qualification, training and retraining of the nuclear installation's personnel. Through that, it guarantees the knowledge of and compliance with nuclear-related regulations.

- **Contracting Party's processes to assess the financial provisions**

According to Article 27 of the Constitution, the generation of nuclear energy and the regulation of its application belong exclusively to the Mexican State, so this state is responsible for assuring the financial resources for the safe operation of the installation.

- **Description of the Contracting Party's arrangements for ensuring that the necessary financial resources are available in the event of a radiological emergency**

CFE's Nuclear Power Plant Division (NPPD) has, by its nature, two special policies:

- LVNPS Liability Policy
- LVNPS Physical Damage Policy

The general conditions of these policies are: Indemnity, legally or by order of a competent judicial authority, the insured must pay third parties for damages to persons and/or property as a result of an event or a series of events that has as its origin, a nuclear or non-nuclear accident that occurs at LVNPS and/or from the use of radioactive facilities.

Article 11 (2) Human Resources

- **Overview of the Contracting Party's arrangements and regulatory requirements concerning staffing, qualification, training and retraining of staff for nuclear installations**

For staffing, qualification, training and retraining of staff for nuclear installations, CNSNS and the licence holders agreed at the outset to implement the requirements of standard ANSI/ANS 3.1-1981 "Selection, Qualification and Training of Personnel for Nuclear Power Plants." However, in the case of nuclear power plants, in November, 2000, the requirements

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of the Mexican Official Standard NOM-NUCL-034 "Requirements for Selection, Qualification and Training of Personnel for Nuclear Power Plants" entered into force. It should be noted that this standard was subjected to the five-year review process. The new version was published in the Official Gazette of the Federation on August 3, 2009. As of the closing date of this National Report, a newer version, a product of the subsequent five-year review, is in process.

- **Human Resources of CFE's Nuclear Power Plant Division**

The workforce of CFE's Nuclear Power Plant's Division amounts to 1124 permanent employees as of February 2016.

- **Organisation of CFE's Nuclear Power Plant Division**

The organisation of CFE currently has a General Director and five subdirectors of the following offices: Financed Investment Projects, Finance, Operation, Administration, and Modernization and Structural Change. In addition, there is the office of the Internal Controller.

Figure 11.1 shows the current organisation of CFE and the NPPD.

- **Methods used for the analysis of competence requirements and training needs for all safety related activities in nuclear installations**

The Systematic Approach to Training (SAT) has been applied at LVNPS since 2006, defining the training requirements for personnel performing safety-related activities. This methodology is applied to the positions identified in 10 CFR 50.120; other important safety-related positions are covered by training programs defined in the Quality Control Plan.

The set of competencies that need to be developed and maintained by personnel for a given position is determined using Job Task Analysis (JTA), which uses a list of the tasks that require training as its starting point. The selection of the method to achieve the required competencies is based on the information available, which may be one or more of the following:

- Task analysis.
- Competency analysis by group of tasks.
- Competency analysis based on learning objectives.
- Competency analysis based on guidelines.

The objective of the training needs analysis is to determine if changes to processes and procedures, plant modifications, reworks, use of new technology, actual or potential

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performance weaknesses, internal or external operational experience, etc. require training or implementation of other actions to prevent or correct performance weaknesses.

Once the issue or weakness is identified, the technical area generates a Request for Training Needs Analysis. This request may also be generated after evaluating the area performance or whenever the Department Head considers appropriate and calls for a meeting with the Training Committee for their attention. At that meeting, the corrective or preventive actions to be taken are defined. These actions provide feedback to the training programmes in order to make them both more efficient and effective.

- **Arrangements for initial training and retraining of operations staff, including simulator training**

The initial training for Reactor Operators (ROs) consists of basic training in LVNPS's fundamentals and technology, standards, policies and specific procedures. After about a year, the trainees are sent to the plant to become familiar with all plant systems and activities. Subsequently they take a simulator course in the LVNPS full-scope simulator. To accredit the candidate, he is assigned to the Main Control Room (MCR). Finally, they are prepared for the licence examination by reviewing some topics, during which time they receive training on the Emergency Operating Procedures (EOP), both in the classroom and the simulator.

Retraining is carried out every two years and combines at least 40 hours of plant simulator and 60 hours of classroom per year. The retraining covers plant systems, abnormal operation and emergencies, internal and external operational experience, administrative procedures, etc. Additionally, before every refuelling outage, training is carried out, the content of which covers the changes and modifications to be implemented, new fuel, technical specifications, and plant start-up on the simulator, as well as other subjects.

- **Capabilities of plant simulators used for training with regard to fidelity to the plant and scope of simulation**

The full-scope simulator was modernised in 2005 with a new software platform. In 2010, the future Extended Power Uprate (EPU) conditions were implemented in the simulator, before the actual EPU modifications were performed that same year. This strategy helped train the plant's staff on the major changes that would take place in both units, before they were actually implemented.

Likewise, the updates necessary to maintain physical and operational fidelity, with respect to LVNPS Unit 2, were completed.

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- **Arrangements for training of maintenance and technical support staff**

Training of maintenance and technical support personnel is delivered according to procedures which describe the training curriculum. The procedures describe different methods for training (classroom, laboratory, on-the-job training, interim assignments, etc.). Classroom courses focus mainly on theory, while laboratory-based courses include theory fundamentals supplemented with practical exercises in the laboratory, workshops, and on mock-ups.

During the initial training, the trainees attend classroom courses or laboratory-based courses. Then they are assigned to the area in which they are being trained. The assignment duration is oriented to help the technicians "under training" acquire the skills necessary to complete the qualifications as technicians. During this period, the trainees keep attending training such as interim assignments or on-the-job training, as well as classroom and laboratory training, or other complementary training.

Later, during retraining, personnel are trained in those topics that are identified as necessary for maintaining their qualifications. The topics include the actions resulting from the Requests for Training Needs Analysis, operational experience, refresher training or specific needs resulting from personnel performance.

- **Improvements to training programmes as a result of new insights from safety analyses, operational experience, development of training methods and practices, etc.**

External operational experience has required improving procedures, post-drill critique techniques, and the use of human performance tools. Improvements have also been implemented to classroom, full-scope simulator, process simulator, workshops and mock-up training.

Since 2008 a hydraulic loop or Process Simulator has been in operation for practical training on technical subjects, reinforcing the adherence to plant standards, and application of error prevention techniques.

In 2013 LVNPS implemented an Internet-based system that provides workers with operational experience lessons and online evaluation to reinforce the learning.

- **Methods used to assess the sufficiency of staff at nuclear installations**

During the initial training, personnel are evaluated on theoretical aspects through written examinations, while the practical skills are evaluated on-the-job training. For licenced personnel (Reactor Operator [RO] and Senior Reactor Operator [SRO]) the initial training is very rigorous with multiple written examinations, while the practical skills are assessed in the full-scope simulator. The job performance, for all personnel executing safety-related

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functions, is evaluated by observers, using an evaluation card. The results are used to determine a Performance Indicator to take corrective actions when deviations are identified.

- **Policy or principles governing the use of contracted personnel to support or supplement the licencee's own staff**

The principles governing the use of contractor personnel to support or supplement LVNPS staff are established considering two types of contractors:

1. Contractors who carry out their activities under the responsibilities of the Quality Assurance Programme of the NPPD and/or
2. Contractors evaluated and qualified by the Quality Assurance Department of the NPPD, to perform safety-related activities under their own Quality Assurance Programme.

Also the following procedures are established:

- PAA-02 establishes the general administrative process for biddings and preparing contracts.
- PAS-13 establishes the participation of the Quality Assurance Department in the process of contracting safety significant services.
- PAG-27 provides guidelines for the receipt of work performed by contractors to ensure that all work and its associated documentation are properly completed and delivered to CFE.

- **Methods used to assess the qualification and training of contractor's personnel**

Contractors performing safety-related functions are required to present evidence of qualifications of their staff. The documents are evaluated by the Quality Assurance Department and the contracting area. The qualification and training requirements of such personnel are stipulated in the corresponding contract.

- **Description of the national supply of, and demand for, experts in nuclear science and technology**

As stated in the "Measures to develop and maintain competence" section of Article 8, there is very low demand of nuclear professionals because there is only one operating nuclear plant in the country; therefore, the supply of students and graduates from the few universities and institutes of technology that offer nuclear engineering programmes, is very low.

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- **Regulatory review and control activities**

CNSNS evaluates the following: (1) on an annual basis - the revisions of the initial training and retraining programmes of the personnel required in 10 CFR 50.120 (Systematic Approach to Training) and the personnel performing safety-related activities; (2) on semi-annual basis - the performance of the technical staff of the areas of maintenance (electrical, mechanical and, instrumentation and control), chemistry, radiation protection, plant engineering, design engineering, reactor engineering and Field Assistant Operators, and (3) on a quarterly basis - the performance of Reactor and Senior Reactor Operators, as well as the performance of the LVNPS full-scope simulator.

As part of the control measures established by CNSNS is the preparation of the following: (1) the semi-annual results report on the implementation of the Systematic Approach to Training for the personnel specified in 10 CFR 50.120 and reactor engineering; (2) the quarterly results report on the retraining cycles of Reactor and Senior Reactor Operators; (3) the annual results report on the evaluation of ROs and SROs; (4) the biennial programme of retraining for the ROs and SROs; and (5) the annual programme of retraining for the simulator instructors. These reports are presented by the licence holder to CNSNS.

The reports mentioned above are reviewed by the specialist staff of CNSNS. The purpose of the review is to verify that the qualification and training requirements of personnel performing a key function for the safe operation of nuclear installations are met at all times.

For the case of contractors' personnel, CNSNS has established in the Mexican Official Standards the specific requirements. It is required that the staff of those companies or organisations engaged in any activity or function for more than a year must meet all regulatory requirements for such activity or function.

For cases when an interim activity or function is performed for less than one year, CNSNS, as part of its Baseline Inspection Programme, verifies that the personnel of the contractors have been accredited by the nuclear installation, and they are duly qualified to perform the task assigned. The verification is performed using one of the following options:

1) Contractor documents which were used to qualify its personnel to perform the assigned task;
2) Previous verification of the ability of the contractor's personnel to perform the task assigned, by personnel of the nuclear installation;
3) Successful completion by the contractor's personnel of those licence holder´s training programme segments regarded as necessary to perform the task assigned.

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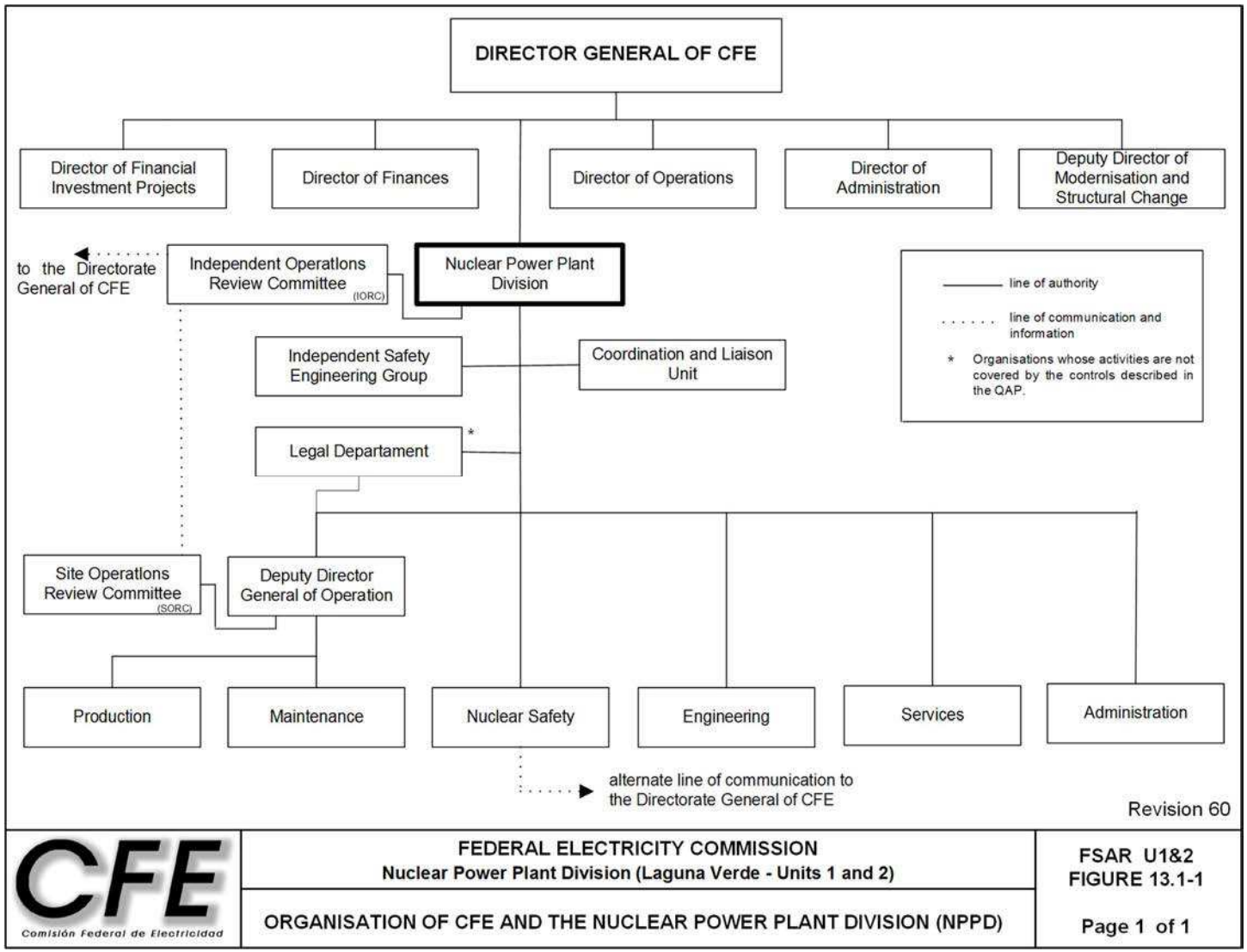

FIGURE 11.1 FEDERAL ELECTRICITY COMMISSION (CFE) NUCLEAR POWER PLANT DIVISION ORGANISATION CHART

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ARTICLE 12. HUMAN FACTORS

Obligations

"Each Contracting Party shall take the appropriate steps to ensure that the capabilities and limitations of human performance are taken into account over the lifetime of a nuclear installation."

- **Overview of the Contracting Party's arrangements and regulatory requirements to take human factors and organisational issues into account for the safety of nuclear installations**

As mentioned in Article 7, since the inception of the Laguna Verde Nuclear Power Station (LVNPS) Project, government authorities decided that, in addition to applying the regulations of the International Atomic Energy Agency (IAEA), the regulations of the Nuclear Steam Supply System (NSSS) supplier's country of origin would be equally applied. This requirement is stated in Condition No. 3 of the License for Commercial Operation for both LVNPS units. For this reason, 10 CFR 50.34(f)(2)(iii) is applied in the Mexican regulation, which requires a variety of controls and displays to aid to the operator, and a control room that reflects the state of art of the Human Factors Engineering principles.

- **Consideration of human factors in the design of nuclear installations and subsequent modifications**

As a result of the accident at the Three Mile Island Nuclear Power Plant in 1979, the United States Nuclear Regulatory Commission (USNRC) published the document NUREG-0660, and later on NUREG-0737 and its Supplement No. 1. These documents required a detailed revision be performed of the design of control rooms (item I.D.1) at nuclear power plants in operation and under construction as well, to be equipped with a Safety Parameter Display System (SPDS) (item I.D.2) in order to improve the human-machine interface, and in this way, reduce the probability of occurrence and the severity of operator error as well as to help them in their decision-making during abnormal and emergency conditions.

To meet the requirements mentioned above, CFE issued the "General Plan for LVNPS Unit 1 Main Control Room Design Review." Once the plan's activities were concluded, CFE forwarded to CNSNS the document "Report on LVNPS Unit 1 Main Control Room Design Review," in compliance with the requirement established in 10 CFR 50.34(f)(2)(iii).

Regarding the compliance of Unit 2 with the requirements of NUREG-0700 and NUREG-0801, it was agreed with the CNSNS to execute a two-phase project plan, taking into account that LVNPS has twin units that are identical in design, except for a few very specific differences. During the first phase of the project plan, all Unit 1 changes were implemented in Unit 2. In the second phase, all the differences between the control rooms were identified. Then, based on the documents generated, several inspections were performed. In the second

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phase, a Job Task Analysis (JTA) of the Emergency Operating Procedures (EOP) was also performed and the results were used to develop several accident scenarios, which were used for training the Unit 2 crews on the LVNPS full scope simulator. In order to be able to fulfil the activities in the second phase, CFE issued and put under the consideration of the CNSNS, the "LVNPS Unit-2 General Control Room Design Review Plan".

As part of the improvements introduced to the design since the start-up of LVNPS Units 1 and 2, there is an SPDS in each unit's control room that is an integral part of the Process Data Integral System, which is used to monitor and record all process parameters. This system allows the operator to have real time visualization as well as a retrospective view of the behaviour of the most important process parameters, allowing appropriate decision-making and reducing possible errors. Also LVNPS constantly has been making improvements to the control rooms, which are logged in the Corrective Action Programme (CAP).

It has been reported in previous National Reports that CFE satisfactorily concluded the execution of the programme for reduction of alarms presenting problems in order to achieve the "Blackboard" condition. A list was made of the alarms that had operated inadequately since the original design of LVNPS Units 1 and 2. The design modifications to eliminate the alarms with problems were performed in accordance with the established programme. This issue arose during the pre-start-up testing of both LVNPS units, caused by configuration problems manifested by faulty alarms. Also during the 2010-2012 period the "Blackboard" condition was reviewed, and is currently maintained in both LVNPS control rooms.

Additionally, in order to improve human performance and error prevention at LVNPS, the Department of Human Performance was established. This group promotes awareness on the Fundamentals of Human Performance and its application in plant activities. These actions are based on a proactive attitude to prevent errors, with the main objective to achieve safe and reliable performance.

Also, the results of the Levels 1 and 2 Probabilistic Safety Analysis (PSA) and human reliability analysis are continually considered to identify accident sequences where the human factor is a major contributor to the core melt frequency. The specific application of these results is through the simulation of the dominant sequences in the full scope LVNPS simulator to train and test operators on appropriate responses.

Moreover, in what could be regarded as LVNPS human performance good practice, the following operative aids were implemented:

a) Symptom-based procedures with flow charts and operational support devices to handle operational transients and accidents, which will allow the operators to respond adequately to these types of events.

b) SPDS was installed in the simulator and training material was prepared for abnormal or emergency conditions.

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c) Use of self-assessment and self-checking verification card (golden card).

d) Since 2000 there has been a group of specialists to perform root cause analysis. In 2004 the group was incorporated into the Corrective Action Programme Group (CAPG), the same year that the Corrective Action Programme was implemented. The CAPG took over coordination of overall assessments, giving greater importance to the root cause analysis. The Performance Improvement Process Committee was formed in 2015 to implement continuous performance improvement, through the implementation and monitoring of the most important process indicators at LVNPS.

e) The implementation of the Systematic Approach to Training (SAT) for the training of LVNPS personnel in 1999.

f) Since 1998 the Independent Safety Engineering Group (ISEG) carries out an assessment of the Nuclear Power Plant's Division (NPPD) of CFE Top Management performance, to identify improvements needed in human performance.

g) The permanent personnel passed the courses on Defence in Depth (DID) principles, among others, as part of the Safety Culture Reinforcement Programme.

h) Nuclear Power Plant's Division of CFE personnel in the Operation, Maintenance and Chemical Engineering, Reactor Engineering, Support Engineering and Radiation Protection areas have attended the course "Human Performance Fundamentals for Error Prevention".

i) In 2013 a teamwork reinforcement programme started. The programme has 3-year duration and includes vivid learning in boot camp style of events outside the plant.

The teamwork reinforcement programme is still in progress. The following table shows the progress, with the number of staff that has attended the programme.

Year	Groups per Year	No. People
2013	14	391
2014	11	250
2015	8	200
TOTAL	33	841

In 2016, the programme will be given for 400 employees, in 9 groups, which will bring the total number of workers that have attended the teamwork reinforcement program to 1,241.

j) The control room staff of both LVNPS units has been trained on conservative decision making.

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k) In 2013, light emitting diodes (LEDs) satisfactorily replaced the alarm lamps in the BB-10 panel of the full-scope simulator. The technical feasibility of making the same change in the Main Control Room (MCR) of both LVNPS units was evaluated and concluded to be possible. The change will be included as part of the engineering improvement projects (2017-2021).

- **Methods and programmes of the licence holder for analysing, preventing, detecting and correcting human errors in the operation and maintenance of nuclear installations**

The Human Performance Programme is regulated by the following guidelines:

1.- SGO-DH-01 Tools for Error Prevention Guideline Rev. 5
2.- SGO-DH-03 Procedures Use and Adherence Guideline Rev. 11
3.- SGO-DH-04 Change Management Guideline Rev. 3
4.- SGO-DH-07 Performance at Work Recognition Programme Guideline Rev. 2
5.- SGO-DH-08 Writing Technical Procedures a Step by Step Guideline Rev. 2
8.- SGO-DH-012 Human Performance Programme Indicator Guideline Rev. 3
9.- SGO-DH-015 Management Oversight Programme
10.- Manual of Human Performance Basics

This Human Performance Programme is carried out through the following activities:

- Review and update of the guidelines for the use of human error reduction techniques at LVNPS.
- Establish metrics and indicators, for use by different areas, to identify areas of opportunity for human performance-related events that have occurred at LVNPS.
- Communicate the use of error reduction techniques through training involving electronic devices and multi-media.
- Perform the trend analysis of the human performance-related events indicator and define with the essential areas the actions to help reducing the gap between the current and expected performance level.
- Perform the root-cause analysis of events reported in the human performance-related events indicator.
- Observe work activities and processes, and prepare a report to provide short-term feedback on the gaps identified to the departments involved.
    - Adopt leadership behaviour to align processes and organisational values to optimise worker performance at the workplace using error reduction techniques.

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- Promote a common language and understanding about human performance terminology.
- In coordination with the Training Centre, provide training support for the course on "Human Performance Basics", error prevention techniques and other subject related educational and training applications.

One of the important aspects that has enabled continuous improvement at LVNPS, among others, is the implementation and follow-up of the Human Performance Programme for preventing errors. This programme consists of activities to improve staff behaviour by knowledge of human performance basics and through using and applying error reduction techniques to meet the task goals in accordance with LVNPS established standards. These techniques have minimised the events and their safety significance.

The Management Oversight Programme, started in 2013, is designed to promote improved performance of NPPD personnel by observing their work activities, intervening when appropriate, and providing coaching to reinforce expectations and compliance with standards. In 2015 reports on the observed behaviour tendencies were produced quarterly. The programme has 280 observers (non-unionized staff), and all NPPD personnel may volunteer to have their activities observed.

In 2015, an indicator for human performance at the department level was added to the existing one for the organisation level. Using these indicators led to identification of specific areas where the various NPPD departments can improve, as well as areas for improvement at the organisation level, both in management processes and specific key activities. Currently, actions derived from a trend analysis of these event indicators are being implemented with satisfactory results.

Based on observations, self-assessments and industrial experience, between 2013 and 2015, the human performance guidelines were updated in order to provide the NPPD with the highest standards in the nuclear industry.

- Self-assessment of managerial and organisational issues by the operator

The self-assessment performed in 2013 was on the following topics:

- AE-38-13. Prior review of the task.
- AE-39-13. Focused, multidisciplinary self-assessment related to the SOER-10-2 management system.

The self-assessments performed in 2014 were on the following topics:

- AE-47/14. Safety culture.
- AE-48/14. Follow-up self-assessment of the SOER-10-2 management system.

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The self-assessments performed in 2015 were on the following topics:

- AE-41/15. NPPD's human performance programme.
- AE-105/15. Rapid self-assessment, action plan during air leaks in the main condenser.

According to the LVNPS self-assessment programme, each one of these self-assessment reports generates condition reports, which define corrective actions in the respective area. The objective of these corrective actions is to close the gaps identified and contribute to improving LVNPS performance.

- **Arrangements for the feedback of experience in relation to human factors and organisational issues**

The events that occurred during the 2013-2015 period have produced collective efforts aimed to correction and improvement of plant processes, and staff behaviour improvement regarding implementation of high standards. The database, generated by the events reported in the event indicator for human performance allows a collective analysis. The analysis has identified latent organisational weaknesses that are being addressed with several inter-group actions to close the gaps. In addition, this database represents a learning source that will prevent their future recurrence.

Courses of Coaching are another way to provide feedback to the personnel about their performance. Coaching provides the opportunity to the supervisor acting as coach to effectively change the behaviour of another person by means of direct communication, feedback, collaboration and positive reinforcement.

- **Regulatory review and control activities**

As a result of the Three Mile Island (TMI) accident in the United States of America, the CNSNS established as a requirement for LVNPS the implementation of 10 CFR 50.34(f)(2)(iii). The objective of this requirement is that the staff playing a vital role in the efficient and safe generation of electric power (e.g., operators and maintenance personnel) operate, verify and reset the plant equipment and its components in such a way that the causal factors of human error are eliminated as much as possible.

Consistent with this requirement, a general guideline was also established that in order to comply with 10 CFR 50.34(f)(2)(iii), LVNPS should follow the directions of the Standard Review Plan Chapter 18, NUREG-0800 (USNRC, 2004), which in combination with the Human Factors Engineering Programme Review Model described in NUREG-0711, provide detailed criteria to be considered in a Human Factors Programme.

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As a result of the implementation of all tasks required in the Standard Review Plan Chapter 18, the CNSNS reviewed the LVNPS compliance with the human factors engineering principles. Also, to ensure that the conditions to minimise human errors were maintained, the CNSNS established in the current LVNPS Units 1 and 2 Licences for Commercial Operation two requirements to maintain these licences valid. The two requirements are:

a) Requirement No. 2 establishes that the LVNPS simulator should meet the requirements of fidelity, response and reliability. Also the simulator should have the Safety Parameter Display System.

b) Requirement No. 6 establishes that LVNPS must continue and conclude, during 2000, the Alarm Reduction Programme in the Main Control Room, implementing the necessary design changes.

The regulatory control and review activities regarding the Human Factors during the 2013-2015 period that the CNSNS has chosen to carry out are the following:

1. Continue the practices suggested in the "Human Factors Engineering Program Review Model" described in NUREG-0711 whose recommendations can and must be applied during the design, construction and operation of nuclear installations.

   According to this review model, the inclusion of the Human Factors Engineering principles was verified in several CFE activities by reviewing the following items:

   a. Operational experience - CNSNS inspections systematically consider operational experience, as does review of the condition reports, in which the involvement of operational experience is documented. In addition, an evaluation of operational experience, as established in the basic inspection programme, is performed every two years. During these activities the External and Internal Operational Experience evaluation and feedback process is reviewed.

   b. Man-machine interface design - During examinations for new operator licences and renewals for Reactor Operators (RO) and Senior Reactor Operator (SRO), the man-machine interface was continually evaluated in order to identify human error precursors caused by the new controls and operator aids, and to make changes in the Main Control Room if necessary.

   c. Training Programme - CNSNS continually follows the analysis, development, implementation, evaluation, and feedback processes of the Systematic Approach to Training. This approach considers the knowledge and skills that the staff must have to safely perform a task.

2. The root cause analysis of operational events has improved the identification of causal factors of human error, such as: environmental conditions; interface with equipment design or condition; verbal and written communication; training methods and

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qualification of personnel; planning and work practices; supervision methods; and administrative methods.

3. During the period covered by this National Report, an inspection was performed of the human and organisational factors-related activities at LVNPS's Units 1 and 2. The inspection included:

   a. Review of programs related to the evaluation of the human and organisational factors-related activities within the facility, as well as the areas responsible for performing them.

   b. Review of processes related to identification, classification, and resolution of problems related to human and organisational performance.

   c. Review of processes related with the improvement of the man-machine interface in the design and modification of controls, recorders, indicators, and other devices used in the field and in the Main Control Room.

   d. Review of the process of considering human factors issues while drafting changes and modifications to facility procedures.

   e. Review of the process of determining the workforce needed to complete each department's programs and functions.

   f. Review of the process of considering human factors when developing qualification and training programs.

   g. Review of the use of management tools for decision making at the management level.

   The structure of this inspection and the definition of the areas to check were determined taking into account the model defined in NUREG-0711 "Human Factors Engineering Program Review Model."

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ARTICLE 13. QUALITY ASSURANCE

Obligations

"Each Contracting Party shall take the appropriate steps to ensure that quality assurance programmes are established and implemented with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the lifetime of a nuclear installation."

- **Overview of the Contracting Party's arrangements and regulatory requirements for the quality assurance programmes, quality management systems, or management systems of the licence holders**

- **Provisions and regulatory requirements for the quality assurance programmes**

During the commercial operation phase of Laguna Verde Nuclear Power Station (LVNPS) Units 1 and 2, the execution of activities important to safety is regulated through the Quality Assurance Plan (QAP), which was designed to meet the requirements set in 10 CFR 50 Appendix B and NUREG-0800, Rev. 2, according to the regulatory framework established for the LVNPS licencing. This plan has a set of procedures to achieve its implementation, which include all activities covered by the QAP. The procedures are reviewed every two or five years, depending upon their safety significance, as indicated in Article 19 (3).

Also the QAP considers the compliance with the USNRC's Regulatory Guides (RGs), established in the Safety Reports, and the controls and requirements of ANSI/ANS-3.2-1982, with exceptions to be agreed upon with CNSNS.

The QAP also describes the quality assurance requirements and controls that apply to the LVNPS Units 1 and 2 during its useful lifetime, including decommissioning. Besides the QAP scope regarding the four quality assurance categories (plus fire protection and radioactive waste), the QAP has a broader scope; because it includes the Technical Specifications (TS), the software classified as important for safety, the Radiation Protection Programme, the training activities, the Internal Emergency Plan (IEP) and the External Radiological Emergency Plan (EREP), among others.

- **Quality management systems**

If LVNPS adopts a quality system that is internationally accepted, such as the International Organisation for Standardization (ISO) standards, CNSNS would review how these international standards compare with 10 CFR 50 Appendix B. Based on this review, CNSNS must conclude if some requirements are needed, in addition to those already established in the existing regulations.

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- **Status with regard to the implementation of integrated management systems at nuclear installations**

As part of the Federal Electricity Commission's (CFE) Institutional Programme of Total Quality and in compliance with the guidelines of the General Directorate, the Nuclear Power Plant Division (NPPD) permanently maintains a policy of continuous improvement of its Division-wide Quality System. This has allowed certifying the NPPD´s Quality Management, Environmental, and Occupational Health and Safety Systems since September 1997, in January 1999 and November 2002, respectively. So far these certifications remain valid.

In 2005, as a result of the evolution of the management systems of the NPPD, an integral certification of the Quality Management, Environmental and Industrial Safety, and Occupational Health Systems was achieved. Later, in 2007 the NPPD, as part of the generation branch of CFE's Direction of Operation (DO), participated in establishing, implementing and maintaining a multiple-site Integral Management System (IMS) applicable to all workplaces of the DO. The IMS included aspects relating to Quality, Environmental, Safety and Occupational Health based on the requirements of ISO-9001, ISO-14001, and NMX-SAST-001 valid standards. This helps the continuous improvement of the efficiency and effectiveness of the NPPD Management System, and its competitiveness to meet the customer and stakeholder requirements. In October 2008 the IMS certification was achieved, while recertification was received in November 2011 and June 2015. Both in adherence to the international standards listed below.

1995	Accreditation of the Environmental Engineering Laboratory, awarded by the Mexican Accreditation Entity
1997	Institutional Total Quality Award, granted by CFE General Directorate
1997	Certification on NMX-CC-003-1995, equivalent to the ISO-9001:1994 (Quality Management System)
1999	Certification on NMX-SAA-001-IMNC-1998, equivalent to ISO-14001:1996 (Environmental Management System)
2002	Certification on NMX-SAST-001-IMNC-2000, equivalent to BSI OHSAS-18001:1999 (Occupational Health and Safety Management System)
2003	Certification on NMX-CC-9001-2000, equivalent to ISO-9001:2000 (Quality Management System)
2005	Integral Certification of the Quality Management, Environmental Protection and Industrial Safety System
2006	Accreditation of the Metrology Laboratory, granted by the Mexican Accreditation Entity
2006	Migration to the NMX-SAA-14001-IMNC-2004 Standard, equivalent to ISO-14001:2004 (Environmental Management System)
2006	Certification as a Clean Industry, granted by the Mexican Federal Attorney for Environmental Protection
2007	Environmental Excellence Award, granted by the Mexican Federal Attorney for Environmental Protection
2008	2007 National Quality Award
2008	Multi-site Management Integral Certification, granted by the International Entity "Quality Certifications", as part of CFE's DO

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2009	Golden Ibero-American Award, granted by the Ibero-American Foundation of Quality (FUNDIBEQ)
2010	Best in Class Award, based on the Malcolm Baldrige Model methodology, granted by the Asia Pacific Quality Organisation (APQO)
2014	Golden Ibero-American Award, granted by the Ibero-American Foundation of Quality (FUNDIBEQ)
2015	Global Performance Excellence Award (GPEA), granted by the Asia Pacific Quality Organisation (APQO)

- **Main elements of a typical quality assurance, quality management or management system programme covering all aspects of safety throughout the lifetime of the nuclear installation, including delivery of safety related work by contractors**

- **Quality assurance essential elements**

The essential elements of the NPPD's QAP to cover safety aspects during the construction, testing, licencing, operation and decommissioning phases are defined based on the following:

1. All activity related with design construction, testing and operation of Structures, Systems and Components (SSC) important to safety must be conducted under strict management and administrative controls to ensure that the operation of LVNPS Units 1 and 2 does not cause an undue hazard to the public health and safety.

   These controls consist of planned and systematic actions that guarantee the adequate accomplishment of activities related to design, purchasing, fabrication, handling, shipping, storage, cleaning, assembling, installation, inspection, testing, operation, maintenance, reparation, refuelling and changes, are carried out in such a manner that the SSCs important to safety perform satisfactorily in service.

2. The activities above mentioned shall be performed using approved procedures by duly qualified trained personnel. Similarly, the control actions must be performed by independent personnel to the one performing the work under control.

CFE, represented by its General Director, holds the total responsibility for the implementation of the Quality Assurance Plan through the NPPD director, who in turn delegates the responsibility for the development, control and verification of its effective execution to the Chief of the Quality Assurance Department. In order for the Quality Assurance Chief to be able to carry out his/her responsibilities in an efficient and timely manner, he/she has sufficient organisational authority, freedom and support from the NPPD management as well as from the General Direction observed through an alternate line of authority through the Nuclear Safety Division Office.

Four categories were determined to be part of the Quality Assurance Plan. These four categories define the Quality Assurance effort required for Structures, Systems and

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Components, as well as towards suppliers, service contractors, in terms of the safety significance of such components or services.

Quality Assurance (QA) categories

QA-1 Category: Assigned to components, subsystems, systems, structures, processes and services requiring the highest level of reliability in their functioning. It applies to components of the reactor coolant pressure boundary and core support structures wherein a failure may cause loss of the reactor coolant at a greater rate than the normal capacity of the makeup water system.

QA-2 Category: Classification assigned to structures, systems, subsystems, components, processes and services required to:

1. Insert negative reactivity for shutting down the reactor.
2. Prevent rapid insertion of positive reactivity.
3. Maintain appropriate core geometry under any plant process condition.
4. Provide emergency core cooling.
5. Provide and maintain containment.
6. Remove reactor and core residual heat.

QA-3 Category: Classification assigned to components, subsystems, systems, Class 1E equipment, structures, processes and services that:

1. Provide or support any safety system function.
2. Process or contain radioactive waste whose release in the event of a component failure may cause a person within the limits of the site, a whole body dose or its equivalent in any part of the body, greater than 5 mSv.

QA-4 Category: Classification assigned to components, subsystems, systems, structures, processes and services which do not have a safety function assigned, but are Seismic I Category. It also applies to supports that do not have a Seismic I Category, but are designed in such a manner to not harm seismic or safety-related components upon failure.

In order to maintain a very high level of quality two additional categories were defined, and partial fulfilment of 18 Quality Criteria in 10 CFR 50 Appendix B were set in other systems necessary to comply with the objectives of minimising fire risks and radioactive waste control. These categories are:

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QA-SPCI Category: Classification assigned to fire protection components that do not belong to the Safe Shutdown Earthquake Fire Protection System (SSEFPS), but are used to protect areas containing QA category equipment.

QA-RW Category: Classification assigned to process equipment, pipes and valves that are not Class 1, 2 or 3, but form the radioactive waste pressure barrier.

The six quality categories include the application of quality principles to equipment and components in which the function is: to maintain the structural integrity of the coolant pressure boundary, control essential functions (reactivity, core cooling, containment integrity) and handling of radioactive waste (in which a failure would produce doses greater than 5 mSv).

The requirements and controls described in the QAP apply to:

1. Activities affecting the SSC with quality assurance category 1, 2 and 3.
2. Activities affecting the original design conditions and installation of SSC with quality assurance category 4.
3. The development, control, use and modification of the software used in safety-related applications such as calculations, operation and equipment and systems response, calibration of measuring equipment, etc. It also applies to the software used to comply or support compliance with regulatory requirements such as record management, compliance with the Technical Specifications, dose control of personnel, etc.
4. Radiation protection activities and ALARA policies of the plant, as well as environmental radiation surveillance activities required by the Technical Specifications.
5. Activities affecting systems and components with quality assurance category SPCI. The criteria described in the QAP Chapters 3, 4, 5, 7, 10, 11, 14, 15, 16, 17 and 18 will apply, in compliance with Branch Technical Position APCSB-9.5-1 Appendix A. The detailed description of how the Fire Protection Programme complies with the rest of the BTP-APCSB-9.5-1 requirements is provided in Table 9.5-4 of the Safety Analysis Reports.
6. Activities of designing, purchasing, assembling, installation, testing, and systems and components operation that form the radioactive waste pressure barrier (QA-RW Category). The criteria described in QAP Chapters 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16, 17 and 18 will apply.
7. Activities related to the Process Control Programme and the Off-Site Dose Calculation Manual (ODCM).
8. Calibration and maintenance activities of the instrumentation necessary to collect the data required by the TS.
9. Activities related to the Internal Emergency Plan and External Radiological Emergency Plan that are the responsibility of the NPPD.

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10. The compliance with the requirements of the Safety Analysis Reports, Operation Licence and Permits granted by CNSNS and the regulations, codes and standards applicable to LVNPS.
11. Training, indoctrination and personnel qualification activities established in QAP Section 2.5.
12. Reporting activities (according to the position established by CNSNS), for manufacturing defects found in safety-related components.

- **Authorisation to contractors**

There are approved procedures to authorise contractors, which ensure that the work at the LVNPS will be performed based on a Quality Assurance Programme according to 10 CFR 50 Appendix B, either by the contractor's own QAP or by the NPPD's QAP.

The authorisation process for safety-related work to be carried out by contractors is performed considering two types of contractors:

1. Contractors who carry out their activities under the responsibilities of the Quality Assurance Programme of the NPPD and/or
2. Contractors evaluated and qualified by the Quality Assurance Department of the NPPD, to perform safety-related activities under their own Quality Assurance Programme.

- **Corrective actions**

The QAP establishes measures to ensure that the identified conditions adverse to quality (CAQs) be immediately controlled, analysed, corrected and, according to their significance, informed to appropriate management levels.

Currently, LVNPS is implementing an integral corrective action system, called Corrective Action Programme (CAP), which is similar to the one used at all United States of America plants. This programme is part of the continuous improvement efforts and has the objective to promote reporting the CAQs related to nuclear, radiation, and industrial safety; physical security; and internal and external operational experience. One of the CAP's main mechanisms is that the different organisations of CFE´s Nuclear Power Plant Division respond to the Findings documented during CNSNS's inspections and the Deficiencies generated during quality, industrial safety and occupational health audits with the purpose of determining, communicating and planning the appropriate corrective actions.

The CAQs are classified according to their safety significance as: Level 1 (L1), 2 (L2) and 3 (L3). These levels are based on the criteria established and evaluated through the root cause analysis, apparent cause, or direct cause to determine the corrective actions and their

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implementation period, according to their safety significance. During the period 2013-2015, an average of 6,500 Condition Reports (CRs) per year have been issued.

It is important to note that all LVNPS staff has access to the Corrective Action Programme through 1,300 computer stations.

- **Reporting**

There is a licence holder - regulatory body interface through a reporting system based on the regulations listed below:

Reporting	Applicable regulation
Component defects	10 CFR 21
Important deficiencies	10 CFR 50.55 (e)

Reports for component defects correspond to non-conformities in the components design and manufacture, and equipment that affect their performance. Usually these reports are extrinsic to the licence holder and are generated by manufacturers and suppliers of equipment and services important to safety, with the exception of equipment and components that have been procured by the licence holder as commercial-grade and dedicated for use in the nuclear installation.

The Important Deficiency Report (IDR) is a significant breach of the Quality Assurance Programme and even though the original regulation only applies to the construction phase, the licence holder and CNSNS have agreed to keep it valid during the LVNPS operation phase.

It is important to note that the reporting system is managed by CFE´s Quality Assurance Department.

- **Periodic assessment of the quality assurance programme**

CFE´s Nuclear Power Plant Division, in compliance with Condition No. 12 of the LVNPS Units 1 and 2 Licence for Commercial Operation, assesses at least every two years, with independent and qualified staff, the following:

1. Effectiveness of the Quality Assurance Programme, and
2. The performance of the personnel and the organisation of the NPPD, reporting its results to the NPPD Head.

Since 1998, these assessments are conducted by the Independent Safety Engineering Group (ISEG). The ISEG reports directly to the Head of the Nuclear Power Plant Division and is

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totally independent of all functional areas of the NPPD. The basic objective is to verify that the QAP implementation is effective in ensuring safe and reliable operation of LVNPS, and in determining what improvements are needed to promote successful operation.

The effectiveness of the QAP implementation is determined based on the following aspects.

a) Review and assessment of:

1. The performance indicators provided by the Quality Process Resources system of the Corrective Action Programme Management and Control System, which are based on the data gathered about the staff and organisation performance, as well as the SSC related to each one of the 18 QAP criteria.
2. Changes made to the organisation of the NPPD.
3. Quality assurance reviews and audits results.

b) Performance assessment of the Top Management in accordance with the guidelines of the International Atomic Energy Agency (IAEA) Technical Report -369 "Management for Excellence in Nuclear Power Plant Performance":

1. Failure to effectively assign responsibility and authority.
2. Inability to anticipate, identify and correct problems by one self.
3. Failure to achieve and maintain the quality culture.
4. Failure to optimise the use of key resources.
5. Inadequate interaction between organisations.
6. Inability to focus on long-term performance.

- Audit programmes of the licence holders

The Quality Assurance Programme incorporates measures to establish and execute a system of planned audits and surveillances to verify the correct implementation of the QAP requirements in all the organisations responsible for providing a required service. The audits include an objective assessment of the practices, procedures, instructions, activities, performance of the areas, etc., as well as review of documents and records to ensure that the QAP is properly and effectively implemented. The surveillances are carried out by the NPPD Quality Assurance Department.

The NPPD has established the policy that the maximum interval between audits to the same functional area is two years. However, for areas that need more attention due to recurring problems or their situation, audits could be performed more frequently than two years. Also the TS prescribe performing semi-annual and annual audits for some specific areas.

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As an example, the internal audit, operations quality assurance, and engineering quality assurance programmes for the 2013-2015 period are presented in Annexes 13.1, 13.2, and 13.3, respectively.

- **Audits of vendors and suppliers by the licence holders**

CFE's Quality Assurance Department assesses and qualifies all suppliers of equipment, components and services important to LVNPS safety. The assessment is performed by a CFE direct audit of the supplier's or vendor's quality assurance programme or by audits carried out under the Nuclear Utilities Procurement Issues Committee (NUPIC) cooperation programme, since CFE is a NUPIC member. The qualifications are generally based on ANSI/ASME N 45.2.12 "Quality Assurance Programme Requirements for Nuclear Facilities" and ANSI/ASME N 45.2.13 "Quality Assurance Requirements for the Procurement Control of Items and Services for Nuclear Facilities."

As an example, the audit programme of the Suppliers Control Group for 2013 through 2015 is presented in Annexe 13.4.

- **Regulatory review and control activities**

During the construction and operation phases, CNSNS assesses the LVNPS Quality Assurance Programme and its revisions, to verify the programme complies with the requirements set in 10 CFR 50 Appendix B and NUREG-0800, Rev. 2, as it is established in the mandatory regulatory framework for LVNPS licencing. In fact, during this reporting period, a revision of the QAP was prepared to reflect:

- Changes in the organisation of LVNPS;
- Changes in responsibilities between groups;
- Incorporation of the Mexican Accreditation Agency (MAA) to approve the commercial-grade calibration and test services of suppliers accredited by the MAA;
- Inclusion of suppliers certified by ASME; and
- Addition of a supervisor in the main control room to monitor operator performance.

Also, as stated in Article 14, CNSNS, through its Baseline Inspection Programme, reviews the programmes and activities of quality-related areas, such as quality assurance and quality control; the supervision groups such as the Independent Operations Review Committee (IORC) and the ISEG, suppliers and contractors, and programmes for dedication of commercial-grade items and for corrective actions.

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For the Corrective Action Programme, both the resident inspectors (monthly, semi-annually and annually) and the headquarters inspectors (every two years) verify: (1) the CAP effectiveness to identify and resolve problems according to their safety significance; (2) specific problems with generic implications; (3) the impact that the combination of otherwise riskless individual problems have on safety; and (4) if the licence holder is properly logging the information.

Additionally, in order to reduce the response and implementation time a continuous communication channel has been established between CFE's Quality Assurance Department and CNSNS. This communication allows following up on the corrective, preventative, and improvement actions resulting from the findings documented during the inspections carried out by CNSNS at LVNPS.

Finally, by monitoring indicators and evaluating the results of Maintenance Rule (10 CFR 50.65) inspections, CNSNS verifies that the licence holder is following up on issues that may affect the operability and availability of equipment covered by this regulation.

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Federal Electricity Commission (CFE)
BIENNIAL INTERNAL AUDIT PROGRAM

PAGE 1 OF 1 **2012-2013**

2013	AREA or ACTIVITY	Audit No.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
			1 2 3 4 5	6 7 8 9	0 1 2 3	4 5 6 7	8 9 0 1 2	3 4 5 6	7 8 9 0 1	2 3 4 5	6 7 8 9 0	1 2 3 4 5	6 7 8 9 0	1 2 3 4 5	6 7 8 9 0	1 2
	SUPPLIER CONTROL GROUP COORDINATION ACTIVITIES	*AI-156*					▲									
	OPERATIONS QUALITY ASSURANCE ACTIVITIES	*AI-157*									▲					
	ENGINEEERING QUALITY ASSURANCE ACTIVITIES	*AI-158*											▲			

Keys:

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⏩ Audit Rescheduled
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Federal Electricity Commission (CFE)
BIENNIAL INTERNAL AUDIT PROGRAM

PAGE 1 OF 1 **2014-2015**

2014 AREA or ACTIVITY	Audit No.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
		1 2 3 4 5	6 7 8 9	0 1 2	3 4 5 6 7	8 9 0 1 2	3 4 5 6 7	8 9 0 1	2 3 4 5	6 7 8 9 0	1 2 3 4 5	6 7 8 9 0	1 2 3 4 5
SUPPLIER CONTROL GROUP COORDINATION ACTIVITIES	*AI-159*					▲ ▲							
ENGINEEERING QUALITY ASSURANCE ACTIVITIES	*AI-160*				16th RU1		13th RU2			▲ ▲			
OPERATIONS QUALITY ASSURANCE ACTIVITIES	*AI-161*											▲ ▲	

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Federal Electricity Commission (CFE)
BIENNIAL INTERNAL AUDIT PROGRAM

PAGE 1 OF 1 **2014-2015**

2015 AREA or ACTIVITY	Audit No.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
		1 2 3 4 5	6 7 8 9	0 1 2 3	4 5 6 7	8 9 0 1 2	3 4 5 6 7	8 9 0 1	2 3 4 5	6 7 8 9	0 1 2 3 4	5 6 7 8 9	0 1 2
SUPPLIER CONTROL GROUP COORDINATION ACTIVITIES	*AI-162*		▲ ▲						17th RU1			14th RU2	
ENGINEEERING QUALITY ASSURANCE ACTIVITIES	*AI-163*				▲ ▲								
OPERATIONS QUALITY ASSURANCE ACTIVITIES	*AI-164*						▲ ▲						

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Federal Electricity Commission (CFE)
Biennial Operations Quality Assurance Audit Program

PAGE 1 OF 2

2013-2014

2013 AREA or ACTIVITY	Audit No.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
INDEPENDENT SAFETY ENGINEERING GROUP (ISEG)	01/13-UIIS (GAN)	▲											
IN-SERVICE INSPECTION	02/13-ISI (JVG)	▲											
TECHNICAL SPECIFICATIONS	03/13-ETO (DCR)		▲										
PROCESS CONTROL PROGRAMME	04/13-PCP (YRH)		▲										
TRAINING	05/13-ENTTO-C (ART)		▲										
INSTRUMENTATION & CONTROL	06/13-I&C (JVG)			▲									
ORGANISATION	07/13-ORG-C (ART)			▲									
REACTOR ENGINEERING	08/13-IRX (RAB)				▲								
CORRECTIVE ACTIONS	09/13-AC-C (DCR)						▲						
EMERGENCY PLANS	10/13-PEI/PERE (YRH)						▲						
COMBINED ISO / SAST AUDIT	11/13-ISO/SAST-C (RAB)							▲					
REFUEL PLANNING	12/13-PLAN (JVG)								▲				
MAINTENANCE	13/13-MANTO (ART)									▲			
SYSTEMS ENGINEERING	14/13-IS (DCR)										▲		
ENVIRONMENTAL RADIATION MONITORING	15/13-MRA (RAB)											▲	
INDEPENDENT AUDIT OF FIRE CONTROL AND LOSS PREVENTION SYSTEMS	ESPECIAL										▲		
CORRECTIVE ACTIONS	16/13-AC-C (JVG)												▲

Keys:
- ▲ Audit Scheduled
- ▶▶ Audit Rescheduled
- √ Audit Performed
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Federal Electricity Commission (CFE)
Biennial Operations Quality Assurance Audit Program
2013-2014

2014 AREA or ACTIVITY	Audit No.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
		1 2 3 4 5	6 7 8 9	0 1 2 3 4	5 6 7 8	9 0 1 2	3 4 5 6	7 8 9 0 1	2 3 4 5	6 7 8 9	0 1 2 3 4	5 6 7 8	9 0 1 2
LICENCING	01/14-LIC (YRH)	▲											
TECHNICAL SPECIFICATIONS	02/14-ETO (DCR)		16th			13th							
MODIFICATIONS	03/14-MOD (RAB)												
COMMITTEE / INDEPENDENT OPERATIONS REVIEW COMMITTEE (SORV / IORC)	04/14-CROS/CIRO (JVG)		REFUEL U1	▲		REFUEL U2							
TRAINING	05/14-ENTO-C (ART)				▲								
FIRE PROTECTION	06/14-PCI (DCR)												
CORRECTIVE ACTIONS	07/14-AC-C (YRH)						▲						
COMBINED ISO / SAST AUDIT	08/14-ISO/SAST-C (RAB)							▲					
CHEMISTRY	09/14-QUIM (DCR)								▲				
OPERATIONS	10/14-OPE (JVG)									▲			
QUALITY CONTROL	11/14-CC (ART)										▲		
EMERGENCY PLANS	12/14 PEI/PERE (YRH)												▲
RADIATION PROTECTION	13/14-PR (ART)												
CORRECTIVE ACTIONS	14/14-AC-C (YRH)												
INDEPENDENT AUDIT OF FIRE CONTROL AND LOSS PREVENTION SYSTEMS	ESPECIAL											▲	
ENVIRONMENTAL RADIATION MONITORING	15/14-MRA (RAB)										▲		

Keys:
▲ Audit Scheduled
▸▸ Audit Rescheduled
√ Audit Performed
■ Audit Cancelled

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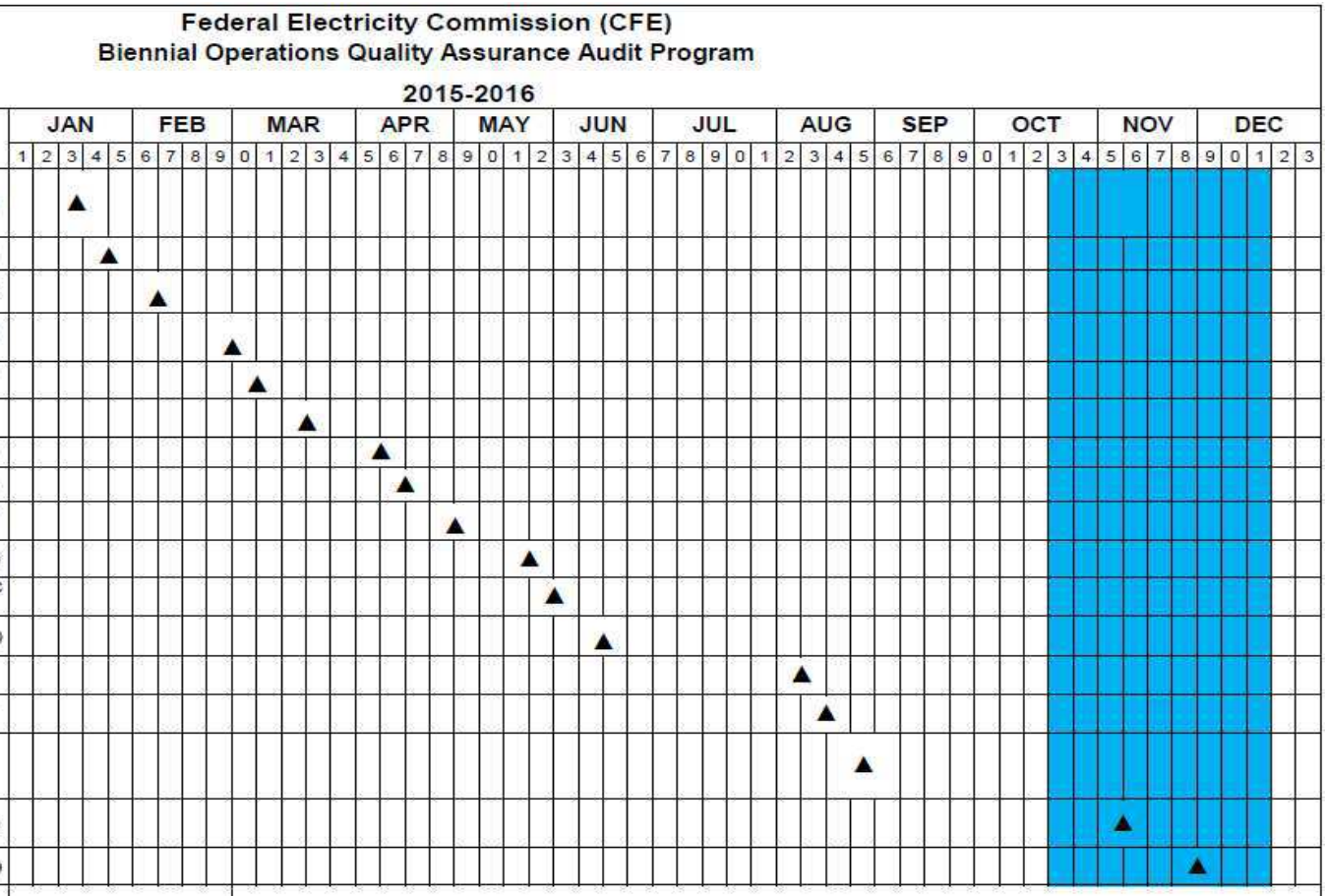
Federal Electricity Commission (CFE)
Biennial Operations Quality Assurance Audit Program
2015-2016

2015 AREA or ACTIVITY	Audit No.
INDEPENDENT SAFETY ENGINEERING GROUP (ISEG)	01/15-UIIS (YRH)
IN-SERVICE INSPECTION	02/15-ISI (RAB)
TECHNICAL SPECIFICATIONS	03/15-ETO (ART)
PROCESS CONTROL PROGRAMME	04/15-PCP (JVG)
TRAINING	05/15-ENTTO-C (DCR)
ORGANISATION	06/15-ORG-C (YRH)
INSTRUMENTATION & CONTROL	07/15-I&C (RAB)
REACTOR ENGINEERING	08/15-IRX (ART)
EMERGENCY PLANS	09/15-PEI/PERE (DCR)
CORRECTIVE ACTIONS	10/15-AC-C (JVG)
COMBINED ISO / SAST AUDIT	11/15-ISO/SAST-C (RAB)
REFUEL PLANNING	12/15-PLAN (YRH)
MAINTENANCE	13/15-MANTO (ART)
SYSTEMS ENGINEERING	14/15-ING SIST (JVG)
INDEPENDENT AUDIT OF FIRE CONTROL AND LOSS PREVENTION SYSTEMS	ESPECIAL
ENVIRONMENTAL RADIATION MONITORING	15/15-MRA (RAB)
CORRECTIVE ACTIONS	16/15-AC-C (DCR)



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Federal Electricity Commission (CFE)
Biennial Engineering Quality Assurance Audit Program

PAGE 1 OF 2 — **2013-2014**

2013 AREA or ACTIVITY	Audit LVI No.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
		1 2 3 4 5	6 7 8 9	0 1 2 3	4 5 6 7	8 9 0 1 2	3 4 5 6	7 8 9 0 1	2 3 4 5 6	7 8 9 0 1	2 3 4 5 6	7 8 9 0 1	2 3 4 5 6 7 8	9 0 1 2 3
Purchases	279/13/COM	▲											
ASME Certificacion, Isometrics and Supoorts	280/13/ISOM		▲										
Engineering Analysis Activities	281/13/AI			▲									
U-1 and U-2 Change Packages	282/13/PM									▲			
Environmental Qualification Maintenance and Dedication	283/13/CAL											▲	

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2013 AREA or ACTIVITY	Audit LVI No.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
		1 2 3 4	5 6 7 8	9 0 1 2 3	4 5 6 7	8 9 0 1 2	3 4 5 6	7 8 9 0	1 2 3 4 5	6 7 8 9	0 1 2 3	4 5 6 7 8	9 0 1 2 3
ININ Activitiies	284/13/ININ				▲								
URS Activities	285/13/URS						▲						
IIE Activities	286/13/IIE							▲					
Engineering Services	287/13/SERV									▲			

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2014 AREA or ACTIVITY	Audit LVI No.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
		1 2 3 4 5	6 7 8 9 0	1 2 3	4 5 6 7 8	9 0 1 2 3	4 5 6	7 8 9 0 1	2 3 4 5	6 7 8 9	0 1 2 3 4	5 6 7 8 9	0 1 2 3
Software Quality Assurance Program	288/14/SW-C	▲								▲			
Programmes and Components Engineering Activities / Field Response Documents	289/14/IPC		U2	▲		U1							
Document, Procedure, and Instruction Control	290/14/PI-C		R-12		▲	R-15							
Contracts and Work Order Requests under CFE's QAP	291/14/SOT-C									▲			

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2014 AREA or ACTIVITY	Audit LVI No.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
		1 2 3 4 5	6 7 8 9	0 1 2 3	4 5 6 7 8	9 0 1 2 3	4 5 6	7 8 9 0 1	2 3 4 5 6	7 8 9	0 1 2 3 4	5 6 7 8	9 0 1 2 3
ININ Activities	292/14/ININ					▲							
URS Activities	293/14/URS		U2			U1	▲						
IIE Activities	294/14/IIE		R-12			R-15				▲			
Engineering Services	295/14/SERV										▲		

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Federal Electricity Commission (CFE)
Biennial Engineering Quality Assurance Audit Program

PAGE 1 OF 2 — **2015-2016**

2015 AREA or ACTIVITY	Audit LVI No.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Purchases	296/15/COM (AGM)	▲											
ASME XI Certificacion, Isometrics and Supports	297/15/ISOM (JMT)		▲										
Engineering Analysis Activities	298/15/AI (AGM)			▲								U-1	
U-1 and U-2 Change Packages	299/15/PM (JMT)				▲								
U-1 and U-2 As-Modified	300/15/AM (BACG)					▲						R-17	
Environmental Qualification Maintenance and Dedication	301/15/CAL (ALC)					▲							

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Federal Electricity Commission (CFE)
Biennial Engineering Quality Assurance Audit Program

PAGE 2 OF 2 — **2015-2016**

2015 AREA or ACTIVITY	Audit LVI No.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
		1 2 3 4	5 6 7 8	9 0 1 2 3	4 5 6 7	8 9 0 1 2	3 4 5 6	7 8 9 0 1	2 3 4 5	6 7 8 9	0 1 2 3	4 5 6 7 8	9 0 1 2 3
ININ Activitiies	302/15/ININ (JMT)						▲						
URS Activities	303/15/URS (BACG)							▲					
IIE Activities	304/15/IIE (ALC)											U-1	
Engineering Services (ULTRA)	305/15/ULT (ALC)								▲				
Engineering Services (DUMEZ)	306/15/DUM (BACG)									▲		R-17	
Engineering Services (IAI)	307/15/IAI (AGM)										▲		

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Federal Electricity Commission (CFE)

Annual Audit Program - Supplier Control Group

2013

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SUPPLIER / CONTRACTOR	NUPIC AUDIT	Audit No.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
PARKER SEALS MEXICO		NLVE-259			10									
CLYDE UNION, INC	23440	NLVE-258			11									
NUCLEAR LOGISTICS, INC	23465	NLVE-260				4								
JAMES C. WHITE COMPANY, INC	23417	NLVE-261				5								
PPG PROTECTIVE & MARINE COATINGS	23467	NLVE-262					20							
PRYSMIAN CABLES Y SISTEMAS, SL		NLVE-263						3						
MEGGITT SAFETY SYSTEMS	23507	NLVE-264						3						
VANATOME		NLVE-265						4						
LAKE ENGINEERING COMPANY	23441	NLVE-266						6						
WESTINGHOUSE ELECTRIC NS ENG SVS	23501	NLVE-267							10 10					
IAI-INGENIERÍA S.A. DE C.V.		NLVE-268								5				
BASF MEXICANA SA DE CV		NLVE-269									9			
SERVICIOS PROFESIONALES S.A. DE C.V. (SERPRO)		NLVE-270										3		
INSTITUTO NACIONAL DE INVESTIGACIONES NUCLEARES		NLVE-271											6	

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Annual Audit Program - Supplier Control Group

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2014

SUPPLIER / CONTRACTOR	NUPIC AUDIT	Audit No.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Energy & Process Co.	23714	NLVE-271	9											
URS Energy & Construction	23782	NLVE-272				5								
United Controls International Inc. (UCI)	23781	NLVE-273					8							
DST Computer		NLVE-274						1						
GE- Hitachi Nuclear Energy - Americas	23723	NLVE-275							8 9					
Global Nuclear Fuel - Americas	23725	NLVE-276								3 4				
Scientech EP	23762	NLVE-277									6			
Natiotal Technical Systems (NTS)	23746	NLVE-278									7			
IHI Southwest Technologies Inc.	23732	NLVE-279									9			
Ergytech		NLVE-257									9			
Geotecnia y Supervisión Técnica		NLVE-280										2		
Schneider Electric Mexico		NLVE-281											5	
Brooks Instrument		NLVE-282												8

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Notes:
1. The NLVE-257 audit was rescheduled for September, at the request of Ergytech, due to organisational changes.

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Federal Electricity Commission (CFE)

Annual Audit Program - Supplier Control Group

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2015

SUPPLIER / CONTRACTOR	NUPIC AUDIT	Audit No.	JAN					FEB				MAR				APR					MAY				JUN				JUL				AUG					SEP				OCT					NOV				DEC			
			1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2
C & D Technologies, Inc	23913	NLVE-285													▲	▲																																								
Ultra Electronics	23990	NLVE-286																				▲																																
Ringo Valves España		NLVE-287																					▲																															
Tecnatom		NLVE-288																						▲																														
Henry Pratt Company	23947	NLVE-289																							▲																													
Engine Systems, Inc	23932	NLVE-290																								▲																												
Preferred Engineering	23977	NLVE-291																									▲																											
ASCo	23904	NLVE-292																									▲																											
Instituto De Investigaciones Electricas		NLVE-293																											▲																								
Westinghouse Electric Quality Prgms	24002	NLVE-294																														▲	▲																				
IHI Southwest	23977	NLVE-295																																				▲															
Amot		NLVE-296																																					▲														

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ARTICLE 14. ASSESSMENT AND VERIFICATION OF SAFETY

Obligations

"Each Contracting Party shall take the appropriate steps to ensure that:

i) Comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its lifetime. Such assessments shall be well documented, subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the regulatory body;

ii) Verification by analysis, surveillance, testing and inspection is carried out to ensure that the physical state and the operation of a nuclear installation continue to be in accordance with its design, applicable national safety requirements, and operational limits and conditions."

Article 14 (1) Assessment of safety

- **Overview of the Contracting Party's arrangements and regulatory requirements to perform comprehensive and systematic safety assessments**

According to the provisions of the Regulatory Law on Nuclear Matters of Article 27 of the Constitution, Chapter IV Articles 25 and 28, and Chapter VI Article 50 Fractions III, IV, V, VII and XIII, CNSNS has the authority for reviewing, evaluating and authorising the bases for the siting, design, construction, operation, modification, cease of operations, definitive shutdown, and decommissioning of nuclear and radioactive installations; as well as everything related to the manufacture, use, handling, storage, reprocessing and transportation of nuclear fuels and materials, radioactive materials and equipment containing them; and the processing, conditioning, dumping, and storage of radioactive wastes; and any disposal of them.

- **Safety assessments within the licencing process and the safety analysis reports for different stages in the lifetime of nuclear installations (e.g., siting, design, construction, operation)**

Safety assessments - construction phase

In 1973 prior to Laguna Verde Nuclear Power Station construction, the CFE presented to the Department of Reactors of the National Institute for Nuclear Energy (identified at that time as the "Regulatory Authority"), the safety analyses corresponding to the: Preliminary Safety

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Analysis Report (PSAR), Preliminary Environmental Impact Assessment Report (PEIA) and Construction Quality Assurance Programme (CQAP).

Subsequently, during this construction phase, the LVNPS installations were subjected to different evaluations, inspections and audits, which were performed by CNSNS and plant organisations as well as external auditors.

1. LVNPS internal audits/inspections

   The audits and surveillances were carried out by the Quality Control and Quality Assurance Departments. The activities of both organisations were continuously performed under a specific programme.

2. Regulatory activities performed by CNSNS

   For the Construction Permit to be awarded, CNSNS evaluated the PSAR. Eight hundred questions were generated from this, resulting in the issuance of 44 amendments to the PSAR.

   The assessment process allowed granting several Provisional Construction Permits. The Definite Construction Permit for LVNPS was awarded in 1979. Later, in September 1992, an extension to the Definite Permit was issued, specifically for completing the construction of LVNPS Unit 2.

   During the construction of LVNPS Units 1 and 2, CNSNS performed inspections and surveillances of activities of design, engineering, installation, special processes and non-destructive testing. Similarly, following a continuous and systematic programme, CNSNS performed audits and inspections to the main suppliers of services and equipment important to nuclear safety. In addition to the aforementioned activities, resident inspectors were assigned to the construction site.

   In order to carry out some of these assessment activities the International Atomic Energy Agency (IAEA) provided technical assistance to CNSNS through experienced personnel.

3. External assessments

   The external assessments had the support of three IAEA missions through the Operational Safety Evaluation Groups and were conducted in January 1986, January 1987 and September 1987. In addition, there was a mission carried out by the Radiation Protection Advising Team in December 1986. There were no substantial defects reported in the LVNPS safety systems, including the administrative and quality assurance systems.

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4. Pre-operational testing programme

The pre-operational testing programme started with the transfer of systems and components from the construction organisation to LVNPS operation personnel. Since the outset of the assessment of this programme, CNSNS developed a work plan which among other activities, included: evaluation of safety-related test procedures, witness tests and evaluation of test results.

Safety assessments during start-up testing

Just like for the pre-operational stage, prior to initial nuclear fuel loading, CFE presented a start-up generic testing programme in order to demonstrate that LVNPS Units 1 and 2 can handle foreseen transients with sufficient safety margins during its operation lifetime. In this respect, CNSNS developed a work plan including among other activities: evaluation of test procedures for safety-related systems, witness of tests and evaluation of test results. The specific details of these activities are presented in Article 19 (1).

Safety assessments - operation phase

1. Licence for Commercial Operation

On June 29, 1979, CFE submitted to CNSNS a Final Safety Analysis Report (FSAR) to support the application for the Licence for Commercial Operation of LVNPS Unit 1. The FSAR was assessed by CNSNS, obtaining acceptable results; therefore, on June 24, 1990 a Licence for Commercial Operation for LVNPS Unit 1 with a thermal power of 1,931 MWt was granted. Given the differences between Units 1 and 2 of LVNPS, in 1994 a second FSAR specifically for Unit 2 was presented for evaluation by CNSNS who determined that this report was acceptable. On April 15, 1995 a Licence for Commercial Operation for Unit 2 at the same power as Unit 1 was issued.

2. First amendment to the Licence for Commercial Operation (105% RTP)

In the second semester of 1995, CFE began approaching CNSNS regarding its intention to performs a 5% thermal power uprate for both LVNPS units. Then in early 1999, CFE presented a formal application to CNSNS. After reviewing the amended sections of the FSAR and the support documentation, CNSNS approved the testing programme in order to verify a stable performance of LVNPS under this new condition.

During the evaluation process, CNSNS asked 55 questions to and held 39 technical meetings with CFE. CNSNS also evaluated the Technical Specifications (TS) that were modified for this new condition. Generally speaking, as a result of these assessments, CNSNS confirmed that it was not necessary to implement any physical changes to the

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Structures, Systems and Components (SSC) of LVNPS Units 1 and 2. CNSNS also witnessed all phases of testing during the rise of power in steps of 1%, concluding that the test results were within the acceptance criteria that were specified.

CNSNS's evaluation and inspections results were documented in a Safety Evaluation Report, which was the basis for recommending to the Secretariat of Energy that a modification of the power in the original Licence for Commercial Operation, from 1,931 MWt to 2,027 MWt, could be granted. Based on the successful results and the favourable opinion of CNSNS, on December 8, 1999, the CFE received from the Secretariat of Energy two new Licences for Commercial Operation for both units of LVNPS, authorising a 5% power uprate up to 2,027 MWt.

3. Second amendment to the Licence for Commercial Operation (120% RTP)

In November 2005, CFE announced its intention to make a 20% power uprate with respect to the power originally licenced. On July 10, 2008, the CFE presented the formal application to CNSNS for authorisation to the Extended Power Uprate (EPU).

As of December 2015, CNSNS had asked 783 questions of CFE, and the evaluation process entered the final stage. The most important assessment issue has been the structural integrity of the reactor steam dryer subjected to acoustic loads, which pointed to the installation of reinforcements for this component in both units. This evaluation is divided into two main stages:

- Acoustic loads on the dryer: CFE used Westinghouse's proprietary Acoustic Circuit Model (ACM) Version 4.2, with stationary wavelet transform (SWT) technology, to determine the pressure loads on the dryer.
- Calculation of fatigue alternating stresses: With acceptance criteria established by CNSNS for the Alternating Stress Ratio for fatigue as greater than or equal to 2.0.

As of the closing date for this National Report, the last concern is regarding the high temperature of the ultimate heat sink, which CFE is in the process of resolving.

4. Assessments during commercial operation

During the commercial operation, the major activities carried out by CNSNS are described below.

a) Assessment of the following:

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1. Proposals of changes to Technical Specifications or amendments to the Licence for Commercial Operation.
2. Changes to the Pumps and Valve Operability Programmes (In-Service Testing) under ASME Code, Section XI, and proposals of exemption to comply with the code.
3. Results of In-Service Inspection (ISI) Programmes under ASME, Section XI for active and passive components, and proposals of exemption to comply with the code (Repairs, Code Cases, etc.)
4. New reactor cores for each Fuel Cycle.
5. Event Reports that are delivered to CNSNS.
6. Activities of ageing control and mitigation (maintenance of environmental qualification, corrosion, radiation embrittlement at the reactor pressure vessel wall, water chemistry, etc.), and structural integrity.

b) Review of the following:

1. Applicability of the internal and external operational experience to LVNPS.
2. Design changes (modifications) to Structures, Systems and Components important to safety.
3. Tests and experiments to be performed at LVNPS.
4. Development and implementation of new regulations.

The assessments of the Change Requests of the LVNPS Units 1 and 2 Licence for Commercial Operation were among the relevant activities for the reporting period. The change requests were to modify the licenced range of the core total flow from 87-107% to 81-107%. This change was known as “Operational Flexibilities”. CNSNS’s assessment covered, among others, areas such as: transient analysis, protection against over pressure of the Reactor Pressure Vessel (RPV), thermal-hydraulic stability, performance of emergency systems, technical specifications, etc.

- **Re-evaluation of hazard assumptions (e.g., according to international best practice, using deterministic and probabilistic methods of analysis)**

CNSNS, in accordance with international practice, uses traditional engineering methods combined with an “risk-informed” approach to make regulatory decisions at LVNPS.

In April 2015, CFE presented LVNPS’s updated probabilistic risk assessment (PRA). Among the main results are:

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- Determination of the source term

  Results from the quantification of 4,259 accident sequences were obtained from 24 containment event trees. LVNPS presented the probabilities obtained from each sequence and the characterization process used to calculate the source term that included the grouping of the release modes and the assignment of release categories.

- Deterministic sensitivity analysis

  CFE presented the deterministic sensitivity analysis, which was performed by varying parameters and conditions in the MAAP 4.08 simulator, for significant phenomena.

- Probabilistic sensitivity analysis

  For the probabilistic sensitivity analysis, LVNPS modified the probability values for some events in the containment event tree, and re-evaluated the accident sequences for all 24 event trees.

As a consequence of the operational experience gained from the event Fukushima Daiichi Central Reactor, occurred on March 11, 2011, the LVNPS:

- Made changes in the Emergency Procedures (EPs).
- Developed Severe Accident Guidelines (SAG).
- Developed flexible strategies (FLEX) to mitigate severe accidents.

Based on this work, CNSNS will require CFE to update the PRA in stage 1 (determination of the damage frequency to the core) and stage 2 (determination of the source term).

- **Overview of periodic safety assessments of nuclear installations during operation, including references to appropriate standards and practices and illustrations on how new evidence is taken into account (e.g., in the light of operating experience, and of other significant new safety information)**

Condition No. 5 of the Licence for Commercial Operation of LVNPS Units 1 and 2 establishes as a requirement a Periodic Safety Review (PSR). This review is not intended to renew the licence every ten years or object to the operation of the plant for the period licenced. It is useful rather to complement the analyses and studies that are continuously carried out to support applications for authorisation of design changes or changes to the Technical Specifications. The PSRs are performed every ten years following IAEA recommendations

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The objective of the Periodic Safety Review is to make an overall assessment about the installation safety conditions including the status of radioactive waste, taking into account operational experience.
The scope of the Periodic Safety Review, using deterministic and probabilistic methods, includes the different aspects of the installation nuclear safety described below:

a) Plant

i) Plant design.
ii) Current status of SSC.
iii) Equipment qualification.
iv) Ageing management.

b) Safety analysis

i) Deterministic Safety Analysis.
ii) Probabilistic Safety Analysis (PSA).
iii) Risk analysis.

c) Performance and operational experience feedback

i) Safety performance.
ii) Use of internal and external experience and research findings.

d) Leadership

i) Organisation and management.
ii) Procedures.
iii) Human factors.
iv) Emergency plan.

e) Environment

i) Radiological impact on the environment.

The PSRs shall analyse the following safety factors:

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Safety Factor No. 1 "Plant design"

The objective of the nuclear plant design review is to determine the design and documentation adequacy with respect to established standards and current international practices.

Safety Factor No. 2 "SSC current condition"

The review objective is to determine the current condition of safety significant SSC, and if they meet the design requirements and the applicable regulations. In addition, the review shall confirm that the SSC condition is properly documented and considered.

Safety Factor No. 3 "Equipment qualification"

The objective of reviewing the factor "Equipment qualification" is to verify that the safety significant equipment installed in harsh environment is environmentally and seismically qualified to perform their safety function during the Licence for Commercial Operation period. It is also verified that the required documentation exists, and that this is a continuous process from the plant design phase until the end of the equipment service life.

Safety Factor No. 4 "Ageing management"

The objective of reviewing the factor "Ageing management" is to verify the SSC performance during the design life of the plant.

Safety Factor No. 5 "Deterministic safety analysis"

The review objective of the deterministic safety analysis is to verify to what extent the analyses of the safety report are still valid, when the following aspects are considered: present facility design; present SSC condition and expected condition by the end of the PSR period, current deterministic methods, standards and current knowledge. In addition, the review shall also identify any weaknesses negatively affecting the Defence in Depth concept.

Safety Factor No. 6 "Probabilistic Safety Analysis"

The review objective of the Probabilistic Safety Analysis is to verify that the scope of the existing PSA remains valid as a representative model of the plant when the following aspects are taken into account: changes in the plant design and operation, new technical information, and operational information.

Safety Factor No. 7 "Risk analysis"

The review objective of the risk analysis is to determine the adequate protection of the nuclear power station against internal and external hazards considering the current plant

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design, site characteristics, actual SSC condition and expected condition by the end of the PSR period, and current analytical methods and safety standards.

Safety Factor No. 8 "Safety performance"

The review objective is to evaluate the safety performance based on the safety indicators defined by the plant.

Safety Factor No. 9 "Use of internal and external experience and research findings"

The lessons learned from internal operational experience and the nuclear industry experience help prevent recurrent operational incidents and potential failures of important equipment that might affect the plant safety. Using this experience helps improve the equipment and processes performance, and human performance, benefitting the nuclear plant operation. It also ensures that the nuclear industry experience is integrated through preventive actions to improve the plant safety and reliability, and prevent similar events.

Safety Factor No. 10 "Organisation and management"

The objective of reviewing the factor "Organisation and management" is to verify that the organisation has set high performance standards for activities related to safe operation of the installation. The leadership shall ensure that the organisation is well structured with clear lines of authority and communication, and that safety policies are well implemented and observed by all personnel.

Safety Factor No. 11 "Procedures"

The review objective is to verify that the procedures have established policies and administrative controls for a safe operation. It shall be established that all activities affecting a safe operation must be indicated in procedures or special instructions ensuring compliance with the Technical Specifications and regulatory requirements.

Safety Factor No. 12 "Human factors"

The review objective is to determine the condition of human factors that may affect the plant safe operation. It is important to include the selection, training and development of personnel who are entrusted with the plant safe performance.

Safety Factor No. 13 "Emergency plan"

The review objective is to verify that the organisation has adequate plans, personnel, facilities and equipment to cope with potential emergencies; the organisation has properly coordinated arrangements with national and local systems; and the integrated response is periodically tested by exercises and drills.

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Safety Factor No. 14 "Radiological impact on the environment"

The review objective is to determine that the installation has adequate programs to monitor and evaluate the radiological impact on the environment, verifying compliance with the established regulatory framework.

- **Overview of safety assessments performed and the main results of those assessments for existing nuclear installations including the summary of significant results for individual nuclear installations and not only according to their type and generation**

Analysis of operational experience

The analysis of the operational experience includes the experience about: a) the operation, b) the operational radiation protection, c) the control of liquid and gaseous effluents, d) environmental radiation surveillance, and e) the solid radioactive waste management for the period considered.

It is important to mention that the Periodic Safety Review for operational experience is performed by methodologies of deterministic analysis.

Analysis of equipment performance

The analysis of equipment performance shall include compliance verification with: seismic and environmental qualification requirements, the Maintenance Rule, the In-Service Inspection Manual, the Surveillance Requirements set in the Technical Specifications and the Management Plan for the plant useful lifetime.

It is important to mention that the Periodic Safety Review for operational experience in this particular topic is performed by methodologies of deterministic and probabilistic analysis.

Design changes

All design changes made to LVNPS's structures, systems, or components (SSC) that modify the design basis are reviewed and assessed, in order to verify that they continue to provide for the safe operation of the plant. The assessment identifies the changes made, including the design requirements as input, in order to perform design checks to ensure the design bases are maintained.

Configuration control

The review is intended to verify: (1) whether the corrective actions resulting from the programme performed for LVNPS's design bases revision have been adequate and fully

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implemented and (2) the existence of a process to ensure maintenance of the plant design bases, and if a design bases change may be needed, the change should be properly controlled, analysed, documented and, handled in accordance with the applicable requirements.

Situation analysis of the new international regulation and the new regulation of the nuclear steam supply system supplier's country of origin

Based on the plant licencing basis requirements, the analysis by the new regulation shall include standards issued by international organisations, specifically, the IAEA safety codes and guidelines, and regulations issued by the Nuclear Steam Supply System (NSSS) supplier's country of origin. The review is intended to verify whether the corrective actions resulting from the new regulation analysis have been adequate and fully implemented.

Management system

The licence holder shall evaluate the implementation progress, effectiveness and improvement actions of the management system. In addition, the licence holder shall conduct a review of the organisation, policies, and strategic and operation planning.

- ## Regulatory review and control activities

Regarding the safety assessments performed by the licence holder, in 1997 CNSNS requested to CFE that the LVNPS Unit 1 PSR report had to include all the FSAR table of contents. Later in 2006, CNSNS established that to meet the LVNPS Unit 2 PSR requirement, CFE should follow the IAEA Safety Guide NSG-2-10, including the radioactive waste situation.

These reports have been delivered by CFE to the regulatory body, complying at all times in a timely and proper manner. These reports allowed identification of areas for improvement, changes, plant ageing issues, operational experience, and technical processes, in order to ensure the highest level of safety and an analysis with respect to the latest standards and practices. The regulatory assessment of the documentation provided by the licence holder did not find any safety-significant issues.

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Article 14 (2) Verification of safety

- **Overview of the Contracting Party's arrangements and regulatory requirements for the verification of safety**

  In accordance with the provisions of the Nuclear Law, Chapter IV Article 32 and Chapter VI Article 50 Section XII, CNSNS has the authority to conduct audits, inspections, verifications and surveys to confirm compliance and adherence to the legal provisions regarding nuclear and radiation safety, physical security, and safeguards; and to execute enforcement actions and decree administrative sanctions as foreseen by this Law and its regulations.

- **Main elements of programmes for continued verification of safety (in-service inspection, surveillance, functional testing of systems, etc.)**

  During the 2013-2015 period, CNSNS has been following the USNRC's Reactor Oversight Process (ROP) guidelines, to comply with the IAEA Safety Guide GS-R-1 "Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety".

  The Baseline Inspection Programme is used for the continuous verification of safety, as part of the ROP. Annexe 14.1 shows the "Control Matrix of Scheduled Inspections" which identifies the Baseline Inspection Programme to be executed every two years. The Baseline Inspection Programme is aimed to collect enough information about the performance of nuclear installations and the licence holder's activities. This allows determining along with the Performance Indicators, when appropriate, if the licence holder is meeting the safety objectives. Another purpose is to identify performance problems so CNSNS can follow-up and take the necessary actions before LVNPS safety is compromised.

  The inspection frequency depends on the type of activity and its significance for the installation's safety, as well as on the results of previous inspections. CNSNS Baseline Inspection Programme indicates the minimum number of scheduled inspections to be performed during the period in which the installation performance has a "response from the installation" status. Additionally, the Baseline Inspection Programme includes some inspections to verify: (1) the quality-related areas, (2) the supervising groups, and (3) the cross-cutting elements.

  It should also be noted that sometimes, there might be the need to conduct special inspections focused on: (1) verifying safety related arising generic issues; (2) following-up when the licence holder performs major manoeuvres, such as functional testing after a power uprate or replacement of major components; (3) responding to issues resulting from the performance assessment using the Performance Indicators and the Findings of scheduled inspections; and (4) verifying the licence holder's response to operational events, which should be evaluated on a case by case basis.

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Both the inspectors from CNSNS's headquarters and the resident inspectors at LVNPS (one resident inspector for each unit) take part in the programme implementation. The resident inspectors also verify daily LVNPS operation, as well as compliance with the Technical Specifications and other regulatory requirements established by CNSNS. The resident inspectors also follow-up the events that occur in the installation and the corrective and preventive actions that are taken to prevent their recurrence.

Additionally, as part of CNSNS continuous verification, the findings documented during inspections and operational events are categorized according to their safety significance. This exercise has the purpose of determining performance indicators similar to the United States Nuclear Regulatory Commission's (USNRC) Reactor Oversight Process performance indicators, in order to compare LVNPS performance with similar plants and emulate the best international practices. During the period covered by this National Report, the existing indicators were updated to incorporate the Mitigating Systems Performance Index (MSPI).

For the Corrective Action Programme (CAP), both the resident inspectors (monthly, semi-annually and annually) and CNSNS headquarter inspectors (every two years) verify: (1) the Corrective Action Programme effectiveness to identify and resolve problems according to their safety significance; (2) the specific problems with generic implications, (3) the impact that the combination of otherwise riskless individual problems have on safety; and (4) if the licence holder is properly logging the information.

- **Elements of ageing management programme(s)**

LVNPS has had, almost from the beginning of its commercial operation, some programmes for ageing management. These programmes have been based on one or more of several sources. LVNPS established a commitment to CNSNS to comply with ASME Code and the USNRC's Generic Letters, as is the case with In-Vessel Visual Inspections (IVVI), In-Service Inspection (ISI), and monitoring of the reactor vessel materials embrittlement. LVNPS also bases its ageing management programmes on operational experience from within and outside the nuclear industry, as is the case with their use of EPRI and INPO Guidelines, and WANO recommendations in the Erosion-Corrosion (EROCOR) programmes, Tanks, and others.

In 2012 LVNPS formally began its application for renewal of its Licence for Commercial Operation for Units 1 and 2, in conformance with the regulatory framework established by CNSNS through application of USNRC's 10 CFR 54 (its guidelines and endorsed standards). Specifically, in accordance with 10 CFR 54.21(a)(1)(i) and (ii), which require applicants to prepare an integrated plant assessment (IPA), CFE performed an assessment to determine which systems comply with the selection criteria established by the scoping and screening process. Subsequently the mechanisms and effects of aging were identified for each combination of material and environmental medium (ageing management review, AMR) and with this information established which ageing management programs (AMP) must be

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implemented to conform with NUREG 1801 Rev. 2. In March 2015, CFE delivered their application for renewal of the Licence for Commercial Operation to CNSNS. In it they committed to implement a total of 47 AMP programmes, including: A) prevention programmes associated with the application of protective coatings on tanks, specifically, and equipment in general, to prevent external corrosion; B) mitigation programmes, including for example, water chemistry to minimize internal corrosion effects in tubes and other equipment; C) condition-monitoring programmes, such as IVVI and ISI; D) function-monitoring programs, where through testing it is possible to determine the capacity of structures and components to perform the functions for which they were designed, for example, monitoring heat exchangers, among others.

These programmes comply with the ten elements established in NUREG 1801 Rev. 2 in order to be valid for licence renewal: 1) programme scope, 2) preventative actions, 3) monitored or inspected parameters, 4) detection of ageing effects, 5) tendency monitoring, 6) acceptance criteria, 7) corrective actions, 8) process confirmation, 9) administrative controls, and 10) operational experience. These programmes will be implemented prior to expiration of the current operating licence (2020 for Unit 1 and 2025 for Unit 2).

At the closing date of this National Report, CFE is preparing new plant procedures and modifying existing ones to comply with these requirements.

- **Arrangements for internal review by the licence holder of safety cases to be submitted to the regulatory body**

As mentioned in the "Overview of the secondary legislation for nuclear safety" section of Article 7 (2) (i), the government authorities decided that, in addition to applying the regulations of the IAEA, the regulation of the Nuclear Steam Supply System supplier's country of origin would be equally applied. For this reason, 10 CFR 50.59 is used to preserve the original licencing bases contained in the information provided to CNSNS, as part of the application for the Licence for Commercial Operation and subsequent application for amendments.

LVNPS procedure PAS-03 is used to prepare, review or approve 10 CFR 50.59 Safety Evaluations, based on the following criteria:

1. Any LVNPS change which could make incorrect or incomplete the information contained in the FSAR, or which may violate a commitment established in that report.
2. Conduction of tests or experiments not described in the FSAR or carried out under different conditions to those described in that analysis report.
3. Any newly known condition at LVNPS that has the possibility of deviation from the concepts presented in the licencing bases.

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4. Activities on structures, systems and components (SSC) that were authorised to have work performed on them or isolated but were not returned to their original condition after completion of these activities, regardless of being inoperable.
5. Changes to the procedures included in Annexe PAS-03-1.

If the safety evaluation concludes that it is not an "Unreviewed Safety Question", LVNPS can implement the SSC changes or modifications without asking approval of CNSNS. However, if the safety evaluation concludes that it is an "Unreviewed Safety Question", LVNPS must request authorisation from CNSNS, before implementing the SSC changes or modifications.

The procedure PAS-03 also establishes that a 10 CFR 50.59 Safety Evaluations is not required in the following cases:

1. Routine maintenance activities described in the LVNPS approved procedures.
2. Work on SSCs that are inoperable, authorised to perform work on them (or isolated), or failed; provided that they do not stay in one of these conditions once they return to normal condition.
3. Data collection in SSC that are operating in their normal condition (alignment, electrical or pneumatic power, supporting, etc.), following normal procedures and within normal operating ranges.

- **Regulatory review and control activities**

Introduction

CNSNS follows up on the licence holder programmes to manage the ageing effects on the SSC, through the Baseline Inspection Programme which includes the following:

- ASME Code Section XI: In-Service Inspection (ISI) and In-Vessel Visual Inspection (IVVI)
- Erosion corrosion (flow-accelerated corrosion)
- Snubbers
- Reactor Pressure Vessel integrity
- Leak testing of primary containment
- Water chemistry
- Quality Assurance
- Corrective Action Programme
- Maintenance Rule

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- Environmental qualification
- Fire protection

Some of these surveillances are described in greater detail in the following sections.

ASME Code Section XI: In-Service Inspection (ISI)

CNSNS continues verifying the In-Service Inspection activities, through periodic volumetric, surface and visual examinations of components and their supports to look for indications of degradation. The LVNPS examinations have been mainly used to verify the structural integrity of Class 1, 2 and 3 mechanical components, such as piping, welding, elbows, etc., according to ASME Code Section XI, Subsections IWB, IWC and IWD guidelines. The examinations also have been used to maintain the components' ASME classification and certification when they are repaired according to ASME Section XI. For all Class 1, 2, and 3 SSC, the volumetric studies are reviewed, and non-destructive inspections, such as ultrasonic, radiographic, liquid penetrant and magnetic particle, are verified.

During the period of this National Report, at the request of CFE, CNSNS authorised the use of the 2004 edition of the ASME codes for both LVNPS units, unifying the mixture of codes that had been applicable because of the different dates of construction and first operation of the two units.

ASME Code Section XI: In-Vessel Visual Inspection (IVVI)

CNSNS audits the In-Vessel Visual Inspection (IVVI) work performed by CFE to verify the structural integrity of the RPV internal components through surface studies, such as visual inspection.

The following internal components of the reactor vessel were given special monitoring:

LVNPS Unit 1:

- Riser Pipe Jet Pumps (pairs 09-10 and 05-06 of Loop "A" of the reactor's recirculation system) – monitor existing cracks and the state of hardware repair parts installed to maintain the integrity of the pumps.
- Core shroud – monitor crack growth and indications.
- Steam dryer - monitor crack growth and indications.
- Moisture separator - monitor crack growth and indications.

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LVNPS Unit 2:

- Riser Pipe Jet Pumps (pairs 01-02 and 13-14 of Loops "A" and "B", respectively, of the reactor's recirculation system) – monitor existing cracks.
- Core shroud – monitor crack growth and indications.
- Steam dryer - monitor crack growth and indications.
- Moisture separator - monitor crack growth and indications.

The above is done without affecting the integrity of the components.

For the 2013-2015 period, CFE submitted periodic reports (after each refuelling outage) which describe the components' condition and the progress of corrective and preventive activities for the previous fuel cycle. The reports are reviewed by CNSNS's evaluation staff.

There were a few specific cases at LVNPS that required a detailed review of structural integrity issues by CNSNS's evaluation staff. The review, which complied with the acceptable criteria as defined in ASME Code Section III, used advanced fracture mechanics methodologies both in the elastic-plastic and the plastic-collapse analysis areas, for the following cases:

1. Unit 1 jet pump riser pipe:
   a. Jet pump pair 09-10, for the installation of additional hardware components.
   b. Jet pump pair 05-06, for the installation of new, long-term hardware components.
2. Cracks in Unit 2 core shroud circumferential welds, re-evaluation of the circumferential welds to support re-inspection during a future refuelling.

Post-Fukushima Daiichi Actions at LVNPS

Results from external events re-assessment

Earthquakes

Based on the Stress Test requirements set by CNSNS, CFE asked the Engineering Institute of the National Autonomous University of Mexico (UNAM) to update the seismic information

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and the calculation methodologies for the Design Basis Earthquake (DBE) maximum acceleration assessment in order to confirm that the seismic design basis remains valid.
The seismic deterministic risk assessment consisted of the following:

1. Reassessment of LVNPS seismic risk.

2. Measurements, analytical and empirical studies on the possible effects in the LVNPS-site vicinity.

3. For rock conditions, the response spectra, which might occur at LVNPS, were estimated.

It was found that in all cases, the original design spectrum bounds the spectral accelerations estimated as part of the seismic design basis review and update performed.

It was therefore concluded that the LVNPS seismic design basis was validated by obtaining a Peak Ground Acceleration (PGA) of 0.24g, a value that is lower than the Design Basis Earthquake acceleration or the Safe Shutdown Earthquake (SSE) acceleration of 0.26g. This implies that LVNPS has a design margin of 8% for this initiator event.

Additionally, LVNPS has a Seismic Monitoring System that meets the USNRC Regulatory Guides 1.12 Rev. 2 and 1.166 Rev. 0. LVNPS also features tri-axial accelerometers, alarm annunciation in the control room of both units, and a procedure to obtain data from external sources if the monitoring system is inoperable. This system does not have mechanisms for an automatic shutdown of the plant.

A comparative evaluation of the seismic design basis of Fukushima Daiichi and LVNPS plants was performed as part of the activities and the specific verification testing already started by CFE after the Fukushima Daiichi nuclear accident. It was concluded that during the Fukushima Daiichi event the actual acceleration measured at the site reached a PGA of 105% (0.63g) DBE (0.60g), while for LVNPS the maximum accelerations recorded by the seismic monitoring network have not exceeded 10% (0.01 to 0.02g) DBE (0.26g).

The LVNPS seismic design basis review and update was completed in the second half of 2012.

CNSNS completed its review of the new seismic study, and is in agreement with CFE's general conclusions that there is an 8% margin for the Design Basis Earthquake and that the earthquakes perceived at LVNPS have had only minor impact on its structures.

<u>Flooding:</u>

CFE conducted a review and update of LVNPS design basis flood. The scope included using the original methodology and validation of the data used. The original work related to the design for flooding was reviewed, concluding that the original design was made using valid methodologies and data appropriate for the specific conditions at the LVNPS site. The

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assessment utilized the recorded meteorological information for the region of the LVNPS site during its commercial operation period, using the current available technology for flooding risk analysis.

Sea-Land

The analysis of the hydro-meteorological conditions from the marine environment that affect the coastal strip in front of the LVNPS site used recorded historical wind data. Different numerical models using that wind data were prepared in order to have summarised statistical information of wind, high tides and storm-induced surge flood in similar conditions to the values used in the original design. The assessment results are the following:

i) High tides analysis

The results of the mean tide level and offshore storm modelling show that approximately 50% of the tides arriving to the area does not exceed a height of one metre. It is important to point out that in case of storms, the tide level reaches heights of 10 to 12 m. The outliers are: a tide level of 11 m with a return period of 100 years, and 13.6 m with a return period of 1,000 years. The critical elevation for Sea-Land high tides flood is the Nuclear Service Water System pumps elevation in the intake structures, which corresponds to an elevation of 6.5 m while the maximum expected flood elevation is 3.66 m; therefore, there is a 2.84 m margin.

ii) Wind analysis

The maximum sustained wind speed that was obtained is the following: 138 km/h for a return period of 100 years, and 175 km/h for a return period of 1,000 years. These speeds are lower than those considered in the LVNPS design, which were: 250 km/h for a return period of 100 years, and 277 km/h for a return period of 1,000 years. The wind gusts speed used for the design of structures in the LVNPS original design was equal to 1.1 times the maximum sustained wind speed. The wind gusts speeds that were obtained are the following: 275 km/h and 304 km/h for a return period of 100 and 1,000 years, respectively. During the assessment a factor of 1.3 was used. The wind gusts speeds that were obtained are the following: 180 km/h and 226 km/h for a return period of 100 and 1,000 years, respectively. It is observed that the latter values are lower than the wind gusts speeds that were used for the original design.

iii) Surge analysis

The storm-induced surge analysis considered two causes: high tides and wind. The surge caused by high tides has a height of 1.31 m for a return period of 100 years, exceeding the breakwaters, inside the basin. The surge caused by wind has a height of 0.69 m for a return period of 100 years. The combination of both gives a total flood level of 1.35 m for a return period of 100 years, and 1.81 m for a return period of

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1,000 years. Therefore, it is concluded that LVNPS design value of 2 m for the flood level is appropriate for the available information and the updated analyses conducted.

Based on the above, the review of design basis flood considering the Sea-Land effects of high tides, wind, and storm-induced surge determined that the updated values are lower than those used in the original design, thus validating the corresponding design bases.

Land-Sea

The analysis of the Land-Sea effects included the Probable Maximum Precipitation (PMP), runoff volumes and the modelling of the hydraulic system. Based on recorded data, the updated PMP and the maximum flowrates in the basins of the LVNPS region are larger than the values used in the original design. The maximum water level in the north area ("Laguna Verde") would be 4 m, and in the south area ("Laguna Salada") 5 m. However, although the updated values are larger than those used in the original design, these levels do not reach the foundation elevation of the buildings, which is 10.15 m. It is considered the LVNPS site has sufficient design margin to prevent the loss of safety functions or fuel damage caused by this natural phenomenon.

Additionally, it was found that the rainwater drainage system has the capacity to dispose of a water volume of 379 mm/h caused by the PMP. This disposal is performed using 4 discharges which were analysed. The analysis, without taking into consideration the last discharge segments, indicates that drainage facilities are sufficient for the rainwater disposal. The original design for flood remains unchanged and there are margins that prevent weaknesses or limiting conditions. In addition, there is no building that would be affected by a flood event.

The LVNPS design basis flood review and update was completed in the first half of 2012.

CNSNS completed its review of the new flood assessment, and is in agreement with CFE's general conclusions that the flood levels are below the LVNPS foundation elevation.

Also as a result of the Special Inspection performed by CNSNS's inspecting staff and carried out in accordance with USNRC Temporary Instruction 2515/183, "Follow-up to the Fukushima Daiichi Nuclear Station Fuel Damage Event", it was determined that LVNPS has to establish a maintenance programme for the following: (1) the seals of the entrance gates to the emergency systems, which are located at elevation -0.65 m of the reactor building, and (2) the roofs of the facility process buildings and the strainers located in the outside areas of these buildings; it was also required to change the seals of the reactor building entrance doors. The monitoring of this maintenance program has been carried out as part of the basic inspection programme.

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Other extreme natural events

Hurricanes

The assessment of the hurricane effects was included in the LVNPS design basis flood review and update.

All LVNPS Seismic Category I structures are designed to withstand Probable Maximum Hurricane (PMH) effects with a wind speed of 275 km/h and a wind gusts of 304 km/h; a design basis tornado with a wind speed of 241 km/h or a design wind speed of 180 km/h. It is assumed that these wind speeds act horizontally at an elevation of 10 m above the ground level. Also, all LVNPS Seismic Category I structures are designed to withstand the effects caused by hurricane winds and missiles generated by a design basis tornado (hurricane).

The Structures, Systems and Components located outside the site (substation equipment, structures and transmission lines) were designed based on a design wind speed of 180 km/h. It is assumed that this wind speed acts horizontally at an elevation of 10 m above ground level. In general, all non-seismic and non-safety-related structures were designed based on the same design wind speed.

CNSNS completed its review of the hurricane impact assessment, and given LVNPS's location in the Gulf of Mexico, this phenomenon, if it were to occur, may induce a loss of offsite power, due to potential damage to transmission lines and structures, as well as means of communication.

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ANNEXE 14.1
CONTROL MATRIX OF SCHEDULED INSPECTIONS

Inspection Area	Initiating Events	Mitigation Systems	Barrier Integrity	Emergency Preparedness	Occupational Radiation Safety	Public Radiation Safety	Baseline Programme	Frequency	Responsible Area
OPERATION UNITS 1 AND 2	X	X	X	X			YES	A	SCO
MECHANICAL MAINTENANCE UNITS 1 AND 2	X	X	X				YES	A	SPV
ELECTRICAL MAINTENANCE UNITS 1 AND 2	X	X	X				YES	A	SPV
I&C MAINTENANCE UNITS 1 AND 2	X	X	X				YES	A	SPV
RADIATION PROTECTION UNITS 1 AND 2				X	X	X	YES	D	SIP
SYSTEMS ENGINEERING UNIT 1	X	X	X				YES	B	SCO
SYSTEMS ENGINEERING UNIT 2	X	X	X				YES	B	SCO
REACTOR ENGINEERING UNIT 1	X	X					YES	B	SCO
REACTOR ENGINEERING UNIT 2	X	X					YES	B	SCO
EFFLUENTS MONITORING UNITS 1 AND 2						X	YES	A	SIP
FIRE PROTECTION UNITS 1 AND 2	X	X					YES	A	SPV
INTERNAL EMERGENCY PLAN				X			YES	A	SCO
TRAINING		X	X	X			YES	A	SCO
MAINTENANCE RULE	X	X	X				YES	A	SPV
REFUELLING ACTIVITIES UNIT 1	X	X	X				YES	R	SR
REFUELLING ACTIVITIES UNIT 2	X	X	X				YES	R	SR
ISI, IVVI AND SNUBBERS UNIT 1			X				YES	R	SPV
ISI, IVVI AND SNUBBERS UNIT 2			X				YES	R	SPV
RADIATION PROTECTION REFUELLING U1					X		YES	R	SIP
RADIATION PROTECTION REFUELLING U2					X		YES	R	SIP
SUPPLIERS UNIT 1							NO	R	SIP
SUPPLIERS UNIT 2							NO	R	SIP
PERFORMANCE INDICATORS	X	X	X	X	X	X	YES	A	SPV
EXTERNAL OPERATIONAL EXPERIENCE							NO	B	SCO
QUALITY ASSURANCE OPERATION							NO	B	SIP

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Inspection Area	Initiating Events	Mitigation Systems	Barrier Integrity	Emergency Preparedness	Occupational Radiation Safety	Public Radiation Safety	Baseline Programme	Frequency	Responsible Area
QUALITY ASSURANCE ENGINEERING							NO	B	SIP
SITE OPERATIONS REVIEW COMMITTEE (SORC)							NO	B	SCO
INDEPENDENT OPERATIONS REVIEW COMMITTEE (IORC)							NO	B	SIP
INDEPENDENT SAFETY ENGINEERING GROUP (ISEG)							NO	B	SIP
DEDICATIÓN PROCESS							NO	B	SIP
QUALITY CONTROL							NO	B	SIP
WASTE MANAGEMENT						X	YES	A	SIP
ASME XI CERTIFICATION UNITS 1 AND 2							NO	B	SPV
ORGANISATION AND HUMAN FACTORS	X	X	X	X	X	X	YES	B	SPV
CORRECTIVE ACTION PROGRAMME	X	X	X	X	X	X	YES	B	SIP
SAFETY CULTURE	X	X	X	X	X	X	YES	B	SCO
OPERATION RTMIII									SCO
MAINTENANCE AND PCI RTMIII									SPV
RADIOLOGICAL PROTECTION RTMIII									SIP
QUALITY ASSURANCE RTMIII									SIP
FUEL FABRICATION PILOT PLANT									SCO

KEYS:

A = Annually
B = Two years
R = Refuelling Outage
D = No Refuelling (this year)
SCO = Subdirection of Certification and Operation
SIP = Subdirection of Inspection Programme
SR= Subdirection of Residence in LVNPS
SPV = Subdirection of Performance Verification

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ARTICLE 15. RADIATION PROTECTION

Obligations

"Each Contracting Party shall take the appropriate steps to ensure that in all operational states the radiation exposure to the workers and the public caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses which exceed prescribed national dose limits."

- **Overview of Contracting Party's arrangements and regulatory requirements concerning radiation protection at nuclear installations, including applicable laws not mentioned under Article 7**

Since there were no national regulations for nuclear power plants at the time the Laguna Verde Nuclear Power Station (LVNPS) was built, government authorities decided that the regulations of the country of origin of the reactor would be applied. Therefore, compliance with USNRC 10 CFR 20, in force at that time in United States of America, was explicitly set as a requirement. Subsequently, in 1988 the General Regulation for Radiation Safety entered into force, which still is valid and is consistent with the International Commission on Radiological Protection's ICRP-26 and with the current 10 CFR 20.

- **Regulatory expectations for the licence holder's processes to optimise radiation doses and to implement the "as low as reasonably achievable" (ALARA) principle**

Article 7 of the General Regulation for Radiation Safety indicates that the dose received as a consequence of an exposition of ionising radiation sources and from practices that involve irradiation with ionising radiation or incorporation of radioactive material, will be subject to a dose limiting system whose fundamental principles are the following:

a) Practices that may produce doses to workers shall not be approved unless a positive net benefit is obtained.

b) The design, planning, use and subsequent application of the sources and practices should be carried out in a manner that ensures that the expositions are maintained as low as possible considering social and economic factors.

c) The establishment of limits for dose equivalents.

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- **Implementation of radiation protection programmes by the licence holder, including:**

▪ **Observation of dose limits, main results for doses to exposed workers**

In order to limit operation personnel doses, LVNPS buildings were divided into zones (reactor, turbine, radioactive waste, liquid purification, Main Control Rooms (MCRs) of both units, hot workshops, and open areas of low potential contamination). These zones include five categories that consider radiation levels according to the following extreme cases:

a) Zone 1 - unlimited permanence is allowed with an exposure rate of less than 25 E-7 Sv/h, when integrated per year does not exceed the 0.005 Sv/year dose limit.

b) Zone 5 - the highest radiation level zone. Access is restricted and controlled.

Also LVNPS has a specific group called "Radiation Analysis and Exposure Control Group", to orient and drive the implementation of the ALARA criterion in all activities developed by its personnel. The group belongs to the organisational structure of the Radiation Protection Department, which is part of the Nuclear Power Plant Division (NPPD) of CFE. The "Radiation Analysis and Exposure Control Group" is responsible for the analysis, evaluation, control, and optimisation of personnel radiation exposure.

Table 15.1 presents a summary of the historic workers' collective and individual average radiation doses for LVNPS Units 1 and 2. Figures 15.1a and b and 15.2 present the historic data for the workers' annual collective radiation dose for LVNPS Units 1 and 2, and for LVNPS, respectively.

Regarding the individual radiation dose, while CNSNS set a Limit for the Total Effective Dose Equivalent (TEDE) of 50 mSv/year, LVNPS adopted in 2003 an administrative average level of 20 mSv/year over a period of five years. This administrative level has been achieved since 2003 and Table 15.1 shows the compliance with it.

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TABLE 15.1

Summary of Workers' Collective and Individual Radiation Doses

Year	Annual Collective Dose (Sv-person)		Annual Dose per MW (Sv-person /MW)		Individual Dose (mSv)	
	Unit 1	Unit 2	Unit 1	Unit 2	Average	High (max)*
1990	1.34435	N/A	0.0055	N/A	1.1610	10.07
1991	5.14748	N/A	0.0106	N/A	2.0520	N/A
1992	5.44015	N/A	0.0122	N/A	2.4510	20.30
1993	1.96603	N/A	0.0035	N/A	1.7460	20.59
1994	6.02126	N/A	0.0125	N/A	2.4020	19.92
1995	4.93073	0.9974	0.0100	0.0025	2.7510	24.75
1996	12.51806	3.6390	0.0288	0.0078	5.4270	37.97
1997	1.94839	2.5529	0.0031	0.0045	2.1140	18.76
1998	5.95528	3.5833	0.0113	0.0067	3.3650	31.72
1999	6.20219	1.1332	0.0117	0.0019	2.1700	21.54
2000	1.33760	4.3173	0.0025	0.0110	2.5800	23.02
2001	3.97322	2.6083	0.0080	0.0052	2.9251	26.75
2002	2.89238	0.5401	0.0058	0.0009	2.1062	17.95
2003	0.66160	3.1542	0.0010	0.0057	1.9926	18.52
2004	3.59474	3.4792	0.0073	0.00626	1.8064	21.72
2005	2.78328	0.5748	0.0048	0.00089	1.0420	14.59
2006	0.65405	2.3086	0.0010	0.00389	0.8612	12.43
2007	3.05512	2.4202	0.0052	0.00405	1.2998	18.72
2008	8.72841	0.6497	0.0192	0.00098	1.9377	22.84
2009	1.30837	3.3115	0.0020	0.00599	0.8803	14.10
2010	6.2316	3.7883	0.0273	0.0086	0.1430	24.74
2011	0.7822	0.8819	0.0013	0.0016	0.0540	17.34
2012	5.2403	3.3184	0.0128	0.0085	2.3300	27.90
2013	0.59175	0.55850	0.0009	0.0009	0.4971	10.87
2014	5.75491	6.04770	0.0103	0.0120	2.8266	30.76
2015	9.18300	0.48300	0.0188	0.0007	2.4107	29.58
TOTAL	**108.24645**	**50.34750**				

* NOTE: The values presented in this column correspond to the maximum values for that year and they are not necessarily for the same individuals. However, for any individual, the

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average value of 20 mSv has not been exceeded over the last five years.

- **Conditions for the release of radioactive material into the environment, operational control measures and main results**

  There is environmental radiation surveillance information available from the pre-operational phase (9-12 years before the start of LVNPS commercial operation) up to this date. The information has been collected through the surveillance and sampling systems of LVNPS's Environmental Engineering Laboratory. Figures 15.4 and 15.5 present the historical results of the direct environmental surveillance. Such figures make evident that the radiation levels remain on the same order as the levels existing during the pre-operational phase. It is worth noting that during all these years; events non-related to LVNPS have been detected, which contributed to raising the environmental background level.

  The radiological impact to the general public is calculated from LVNPS emissions, using the models established in the Technical Specifications. In all cases, the impact represents a small fraction of the corresponding limits.

  The annual dose due to liquid releases has shown a drastic reduction since 1996, due to improved water re-utilisation management; which substantially reduced liquid releases. This tendency can be observed in Figure 15.6.

  Since 1996, there is a reduction tendency in the public dose due to gaseous releases, which can be observed in Figures 15.7 to 15.10.

- **Processes implemented and steps taken to ensure that radiation exposure is kept as low as reasonably achievable for all operational and maintenance activities**

  ## Introduction

  Figure 15.2 shows that LVNPS's collective dose had a steady reduction tendency up to 2006. However, when the actions and recommendations to protect the Reactor Pressure Vessel (RPV) internals were implemented, this trend was reversed. The application of Hydrogen and Noble Metals produced a substantial change in the reactor water chemistry. The chemical recombination processes produced an increase of the Cobalt 60 (Co-60) concentration, with respect to the values observed in previous years. This change was reflected, in both, the collective dose and the Boiling Water Reactor Radiation Assessment and Control (BRAC) index of both units.

  The radiation control started when the technology to reduce the effects of the intergranular corrosion to the RPV internals was proposed, taking advantage of the best global

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experience. As part of this project, the zinc injection was adopted to control the iron and, consequently, the Co-60, concentrations.

The Dose Reduction Committee is taking dose control measures aimed at the following three fundamental aspects.

a. Source term control (Figures 15.3 a/b)
b. Work practice improvement.
c. Equipment reliability.

Regarding the source term control, the actions include: a reduction of the Co-60 sources (Stellite-free turbines as part of the Extended Power Uprate [EPU] project changes); and use of cobalt-selective resins which are being applied in the Reactor Water Cleanup System, iron control, hydrogen injection control, on-line application of noble metals, and the application of EPRI's water chemistry guide during shutdowns and refuelling outages.

The work practices have been improved using mockups to reduce activity execution time and, consequently, the dose. The use of the human performance tools for error reduction is another action that impacts the dose reduction by reducing the rework required.

As for the equipment reliability, preventive maintenance and the actions before the component failures are considered strategies that have the greater impact during normal operation. For equipment and/or systems recurring failures, the Equipment Reliability Committee recommends which failures are part of the "Top Ten" failures list. Then, the Equipment Reliability Committee proposes specific actions and strategies to solve the problems.

Implemented strategies

The strategies implemented during the period covered by this National Report to reduce LVNPS's collective dose can be summarised as follows:

1. The Dose Reduction Committee was formally founded.
2. Use of the lessons learned from internal operational experiences. For example, the problems identified during the 13th Refuelling Outage of LVNPS Unit 1 were corrected and the improvement actions were implemented in the 10th Refuelling Outage of LVNPS Unit 2.
3. Follow-up to the Dose Reduction Plan commitments.
4. EPRI´s staff advisory on the source term control.
5. Benchmarking with other nuclear plants to adopt the best industry practices.

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6. Appointment of a full time leader to take care of the source term and collective dose reduction. The integration of a working group has been formalized which is formed of Radiation Protection, Chemical Engineering and Engineering Design personnel.

Future strategies

The foreseen collective dose reduction strategies for the 2016-2020 period will be established based on the recommendations of the Group for the Source Term and Dose Collective Reduction, established in the Dose Reduction Plan 2016-2020. The Plan will be approved by the Nuclear Power Plant's Division Head and all LVNPS Departments will commit to its adherence and enforcement.

▪ Environmental monitoring and main results

For LVNPS, CFE has an Environmental Radiation Surveillance Programme which ensures continuous monitoring of the environmental impact during normal operation. The highlights of LVNPS's environmental surveillance are presented below.

Atmospheric releases

a)	External radiation, air	30 sampling stations
b)	Inhale, air	16 sampling stations
c)	Radiation deposited on soil	7 stations
	Rain water	2 station
	Agricultural products	7 stations
	Grass	4 stations
	Milk	4 stations
	Beef	1 station

Liquid effluents

a)	Release to ocean	1 station
b)	Fish	2 stations
c)	Aquatic biotic	1 station
d)	Bio-tracers	4 stations
e)	Sea sediment	4 stations

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f) Beach sand 4 sampling stations

g) Underground fresh water 3 sampling stations

Conclusions

a) The concentration limits set in LVNPS's Technical Specifications have never been exceeded, neither by any single sample nor considering the average.

b) Since the concentration limits were not exceeded and the exposures measured with Thermo Luminescent Dosimeters (TLD) remained below the pre-operational values; it can be established that no member of the general public exceeded the limits due to LVNPS emissions.

c) The total beta activity detected during the reporting period remains well below the Technical Specifications limit, which is a similar behaviour of the previous years. The variations observed from 1978 to date are of the same order.

d) The results from the Environmental Surveillance Programme have shown that the radiation dose for LVNPS's vicinity population has not increased, due to LVNPS operation; or at least, if there is any increase, it cannot be discriminated from the very low values measured during the reporting period.

e) Cs-137 is the only artificial radionuclide that has been detected in the samples with relatively high regularity; Sr-90 appears, but rarely. However, they were detected during the pre-operational surveillances, even before LVNPS construction. It is presumed that nuclear weapons testing produced them and reached the LVNPS site through radioactive fallout. Therefore, the presence of these radionuclides is not attributable to LVNPS operation and they show a very slow reduction trend due to its half-life.

f) During the 2013-2015 period, some radionuclides due to LVNPS operation were detected, including Mn-54, Co-60, Co-58, Cr-51, Zn-65, and I-131, all with very low activity.

- Regulatory review and control activities

Annexe 14.1 presents the "Control Matrix of Scheduled Inspections," which includes the inspections of radiation protection areas, effluents, and radioactive waste management. In addition to the inspections, the performance of the strategic area of radiation protection is monitored through the Reactor Oversight Process (ROP). As part of the assessment, both the general public radiation safety and LVNPS workers' occupational safety fundamentals are considered. In a complementary fashion, during refuelling, statistical data of the workers' collective dose is kept, in order to properly react in case of any unexpected increase.

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Regarding the surveillance of exposure to the public caused by LVNPS normal operation, CNSNS has several mutually independent ways to verify compliance with the current regulation on environmental impact, including the ones listed below.

a) Analysis of the "radioactive emissions" section of the daily production report, which contains real-time data from the instrumentation of the radiation effluents process.

b) Assessment of LVNPS semi-annual accounting reports for effluents. The report consolidates data from sampling procedures and isotopic analyses of liquid and gaseous emissions during the reporting period. The second half year reports are actually an annual summary, which also contain dose calculations and relevant weather information. Part of CNSNS´s assessment is an independent reproduction of those dose calculations to verify its consistency. The assessment is performed in accordance with the USNRC Regulatory Guide 1.109.

c) Assessment of the Environmental Radiation Surveillance Annual Programme Report prepared by an external laboratory, which contains sampling and isotopic analysis information from different environmental strata.

d) An independent assessment of LVNPS Units 1 and 2 radiation environmental impact, through measurement of environmental dose rate through probes in the plant and its surroundings, and an isotopic analysis of environmental samples periodically collected in the plant's vicinity and processed in CNSNS's laboratory. These programmes have functioned as additional verifications, whereby CNSNS has confirmed the consistency of the information submitted by LVNPS's licence holder.

LVNPS and CNSNS laboratories participate in international programmes for inter-comparison to ensure their measurement reliability.

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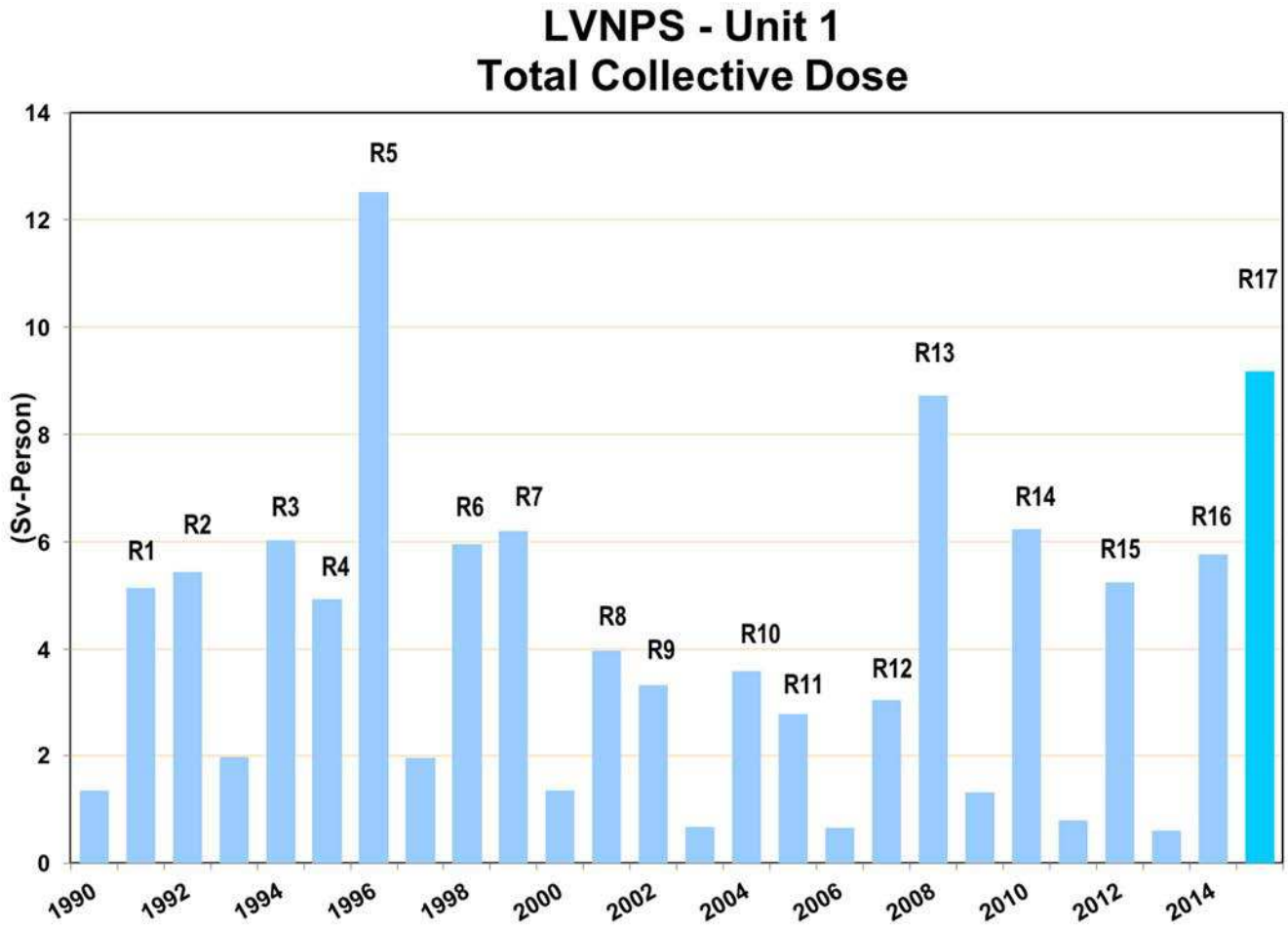

FIGURE 15.1A HISTORICAL DATA FOR WORKERS' COLLECTIVE ANNUAL RADIATION DOSE, 1990-2015, FOR UNIT 1

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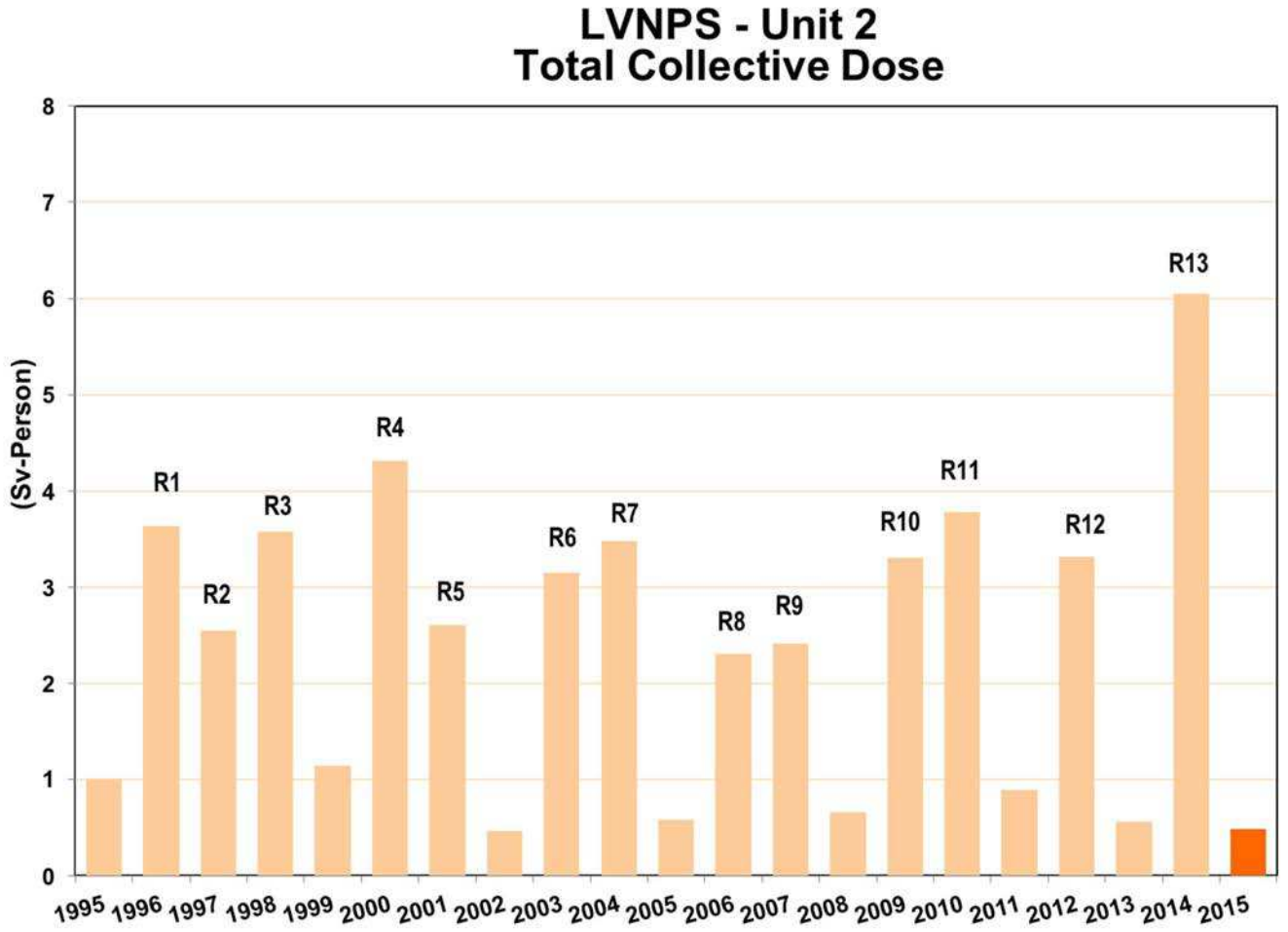

FIGURE 15.1B HISTORICAL DATA FOR WORKERS' COLLECTIVE ANNUAL RADIATION DOSE, 1995-2015, FOR UNIT 2

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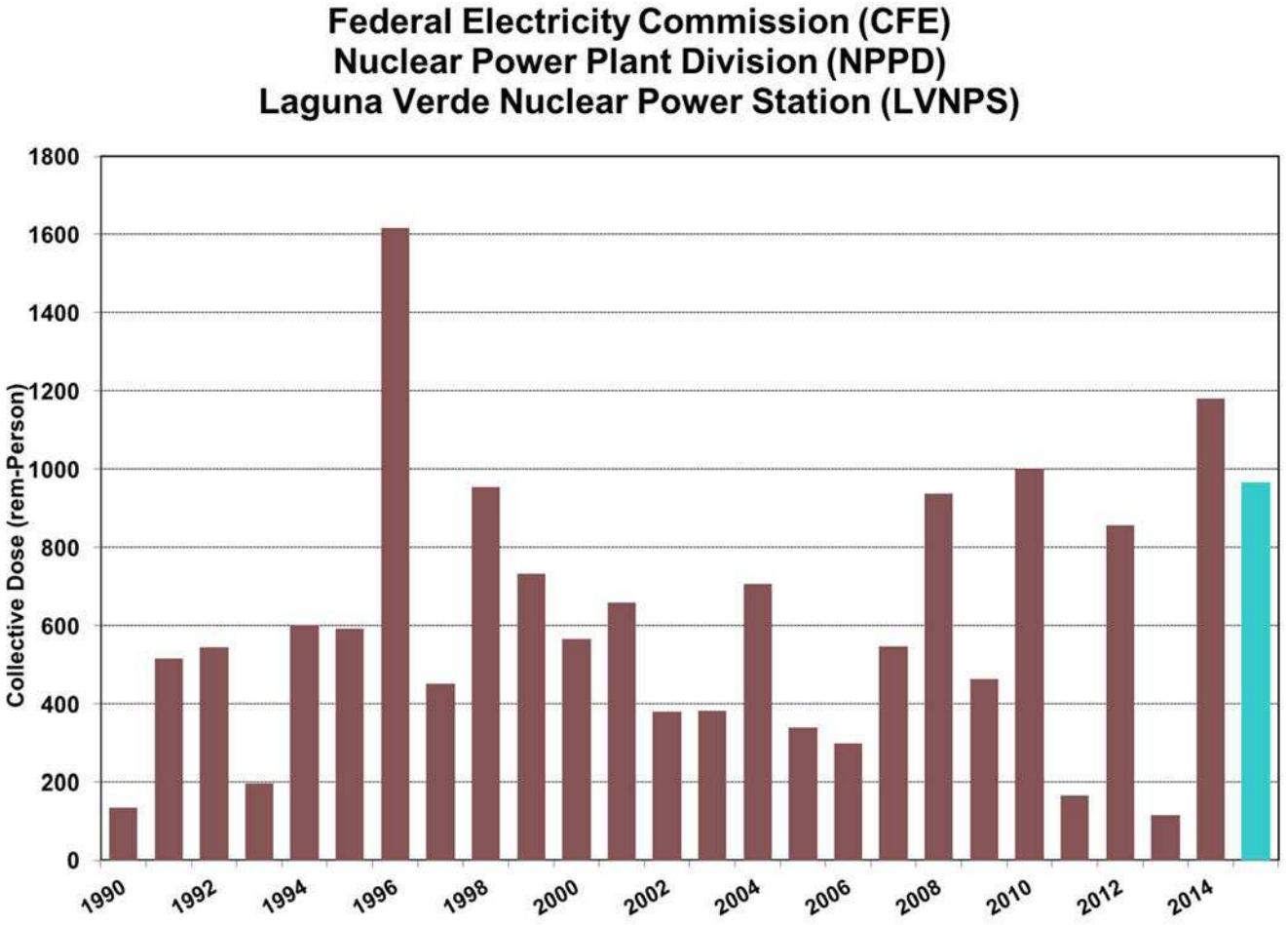

FIGURE 15.2 EVOLUTION OF LVNPS COLLECTIVE DOSE

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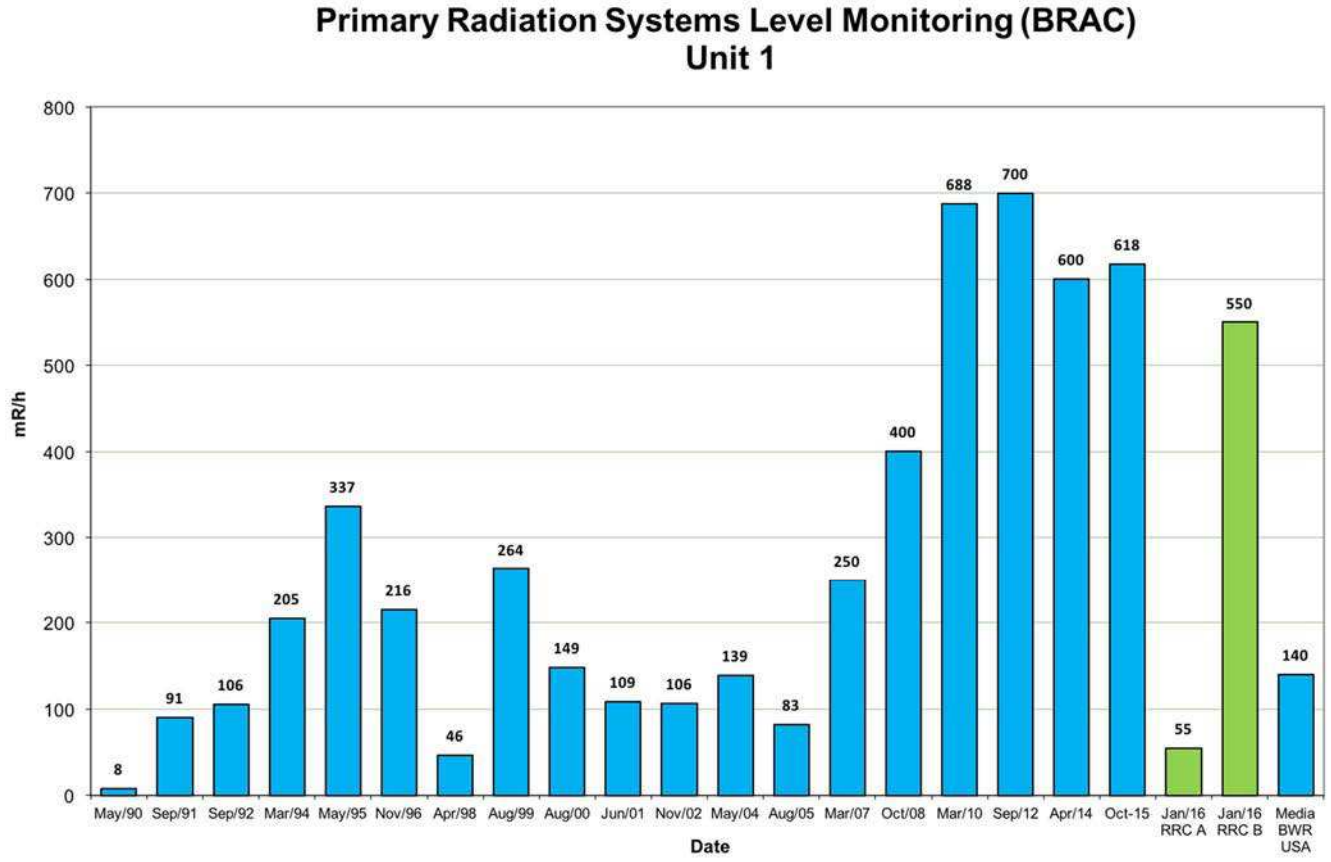

FIGURE 15.3A PRIMARY RADIATION SYSTEMS LEVEL MONITORING (BRAC) FOR UNIT 1

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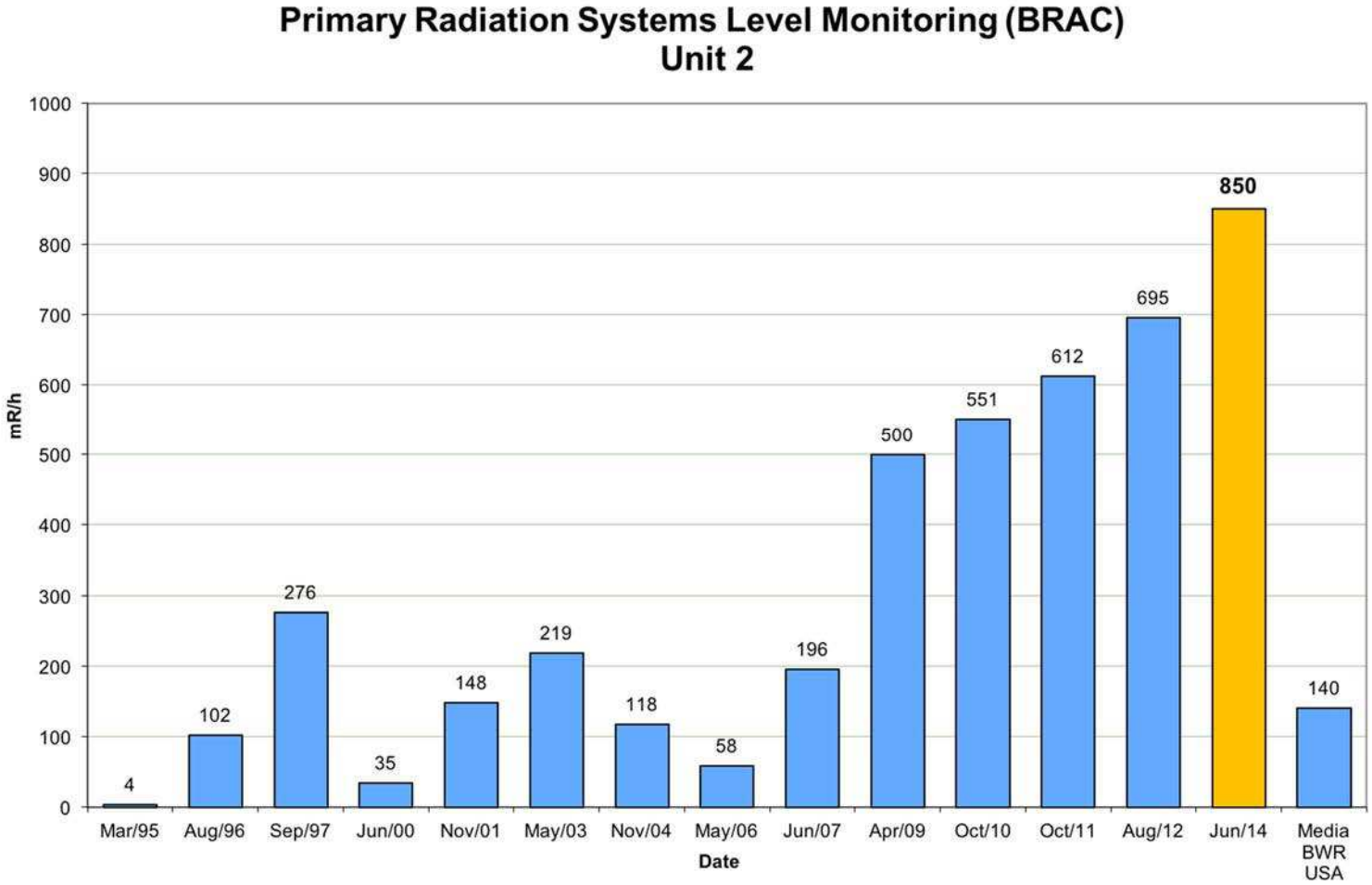

FIGURE 15.3B PRIMARY RADIATION SYSTEMS LEVEL MONITORING (BRAC) FOR UNIT 2

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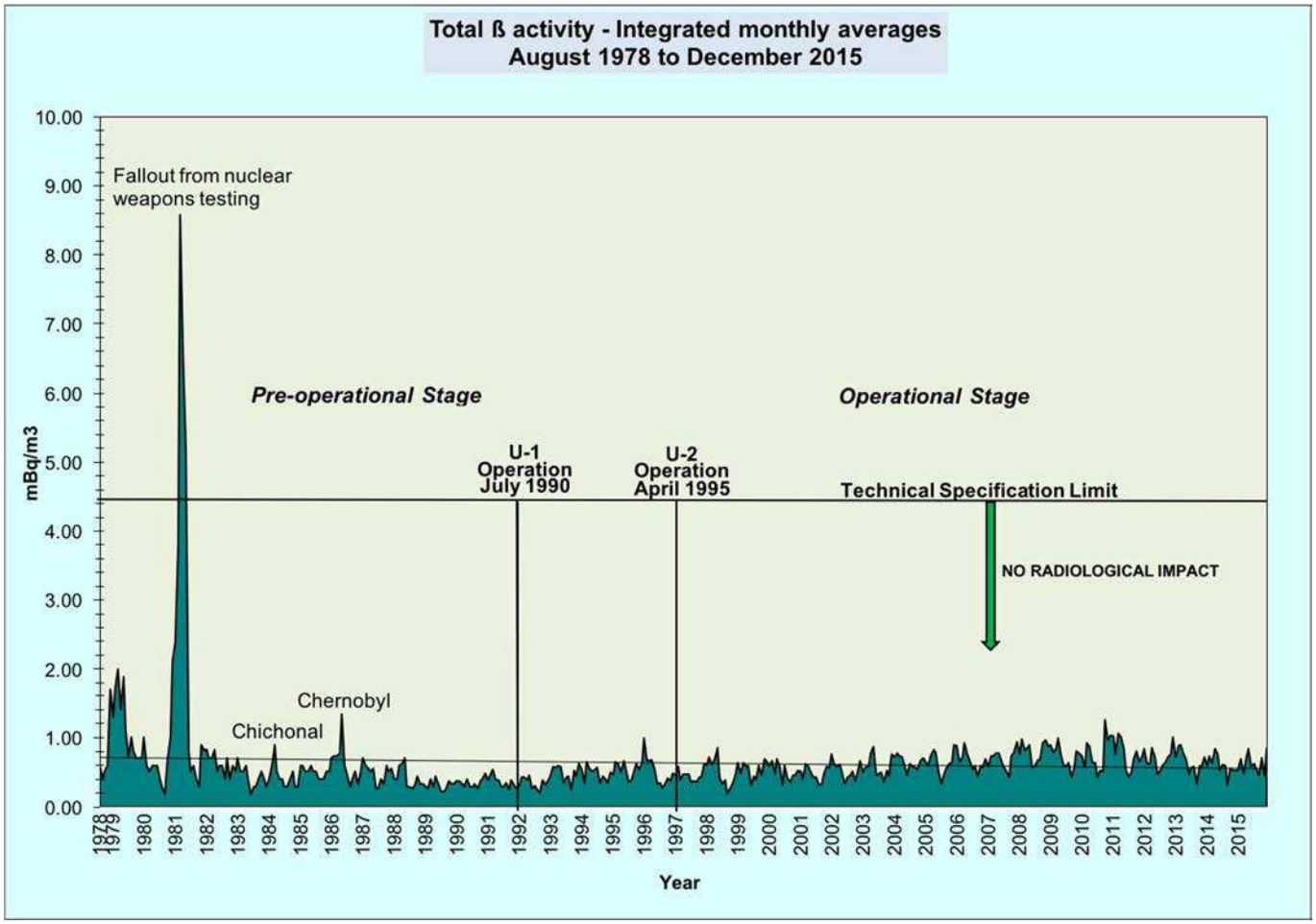

FIGURE 15.4 INTEGRATED MONTHLY AVERAGES OF TOTAL β ACTIVITY

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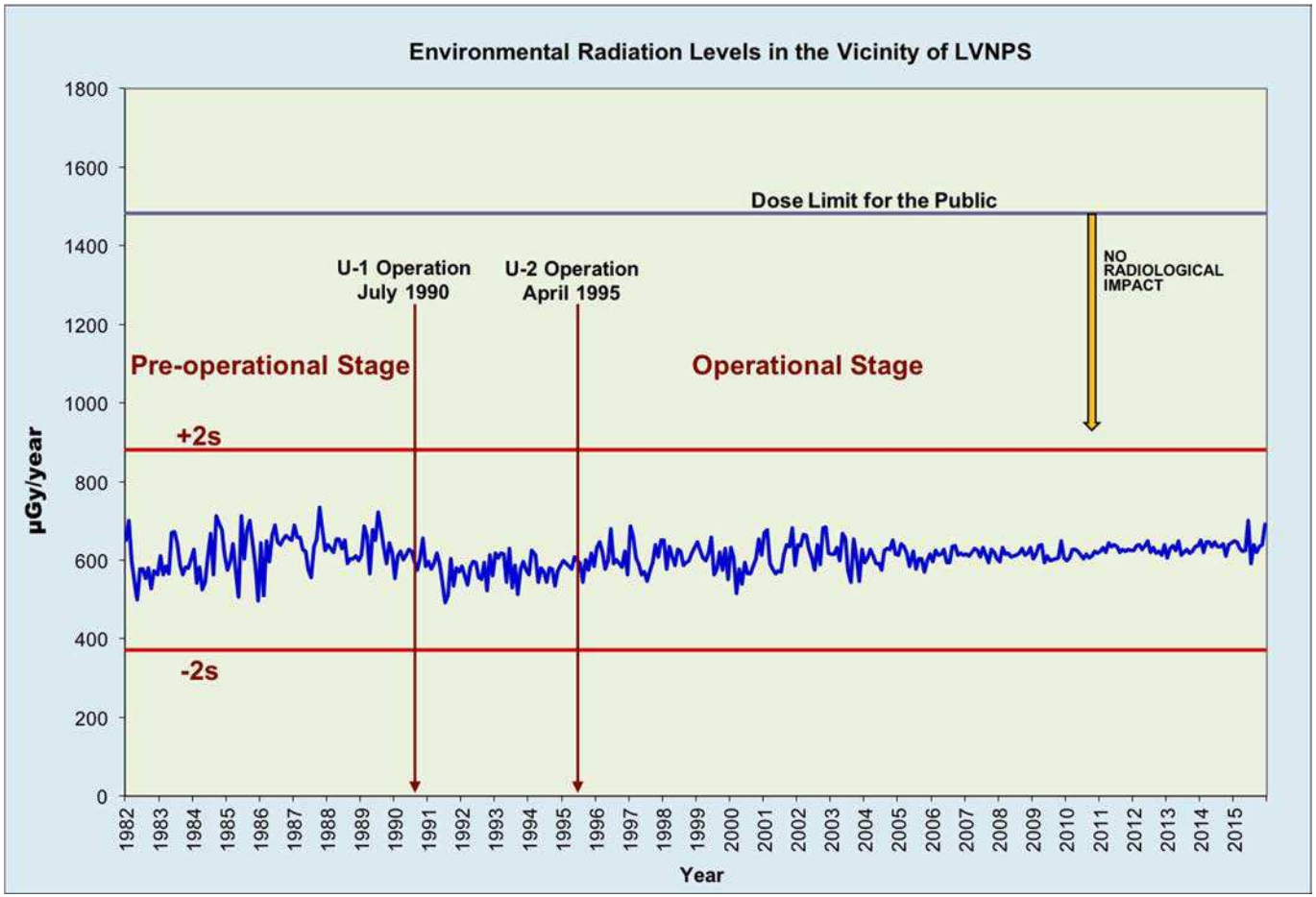

FIGURE 15.5 ENVIRONMENTAL RADIATION LEVELS IN THE VICINITY OF LVNPS

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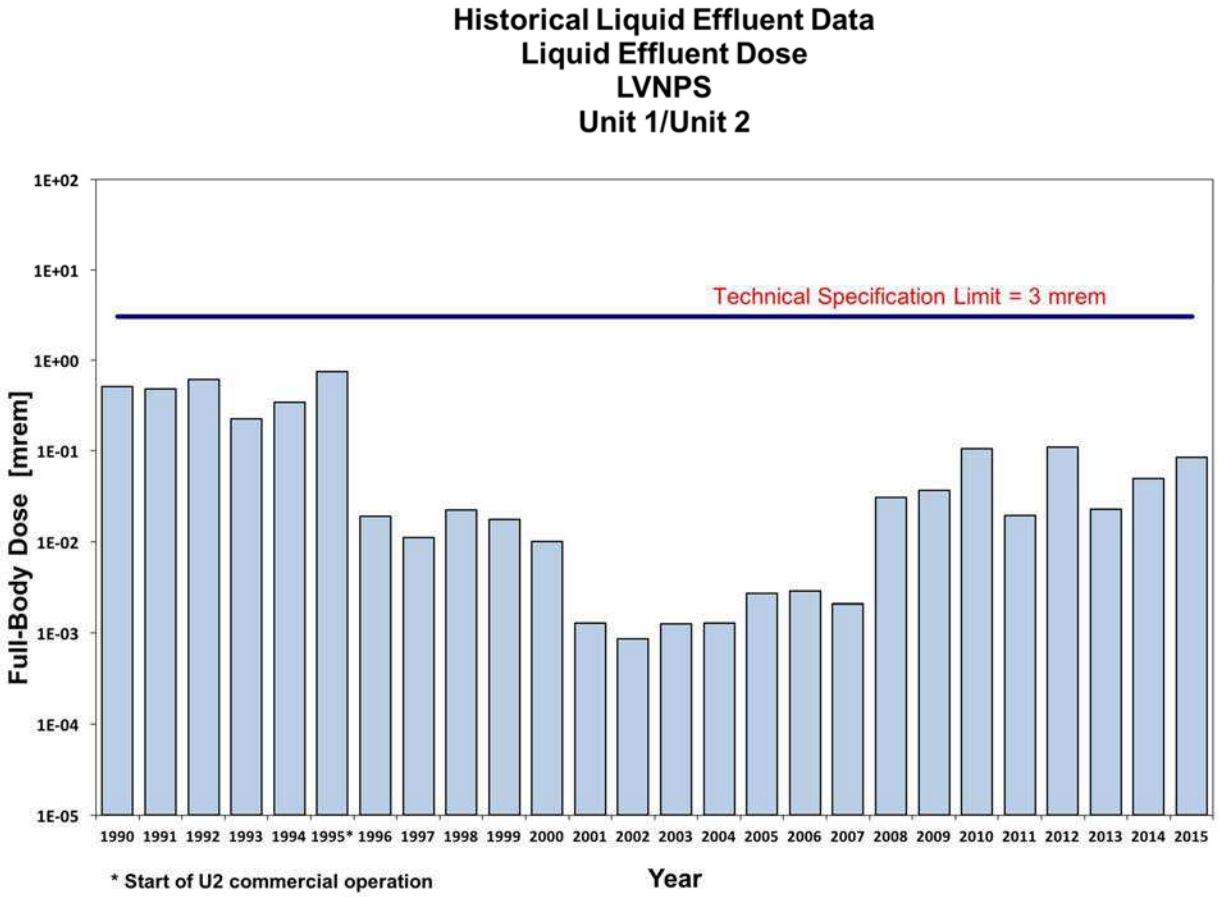

FIGURE 15.6 ANNUAL HISTORICAL DATA OF LIQUID RELEASES (UNITS 1 AND 2)

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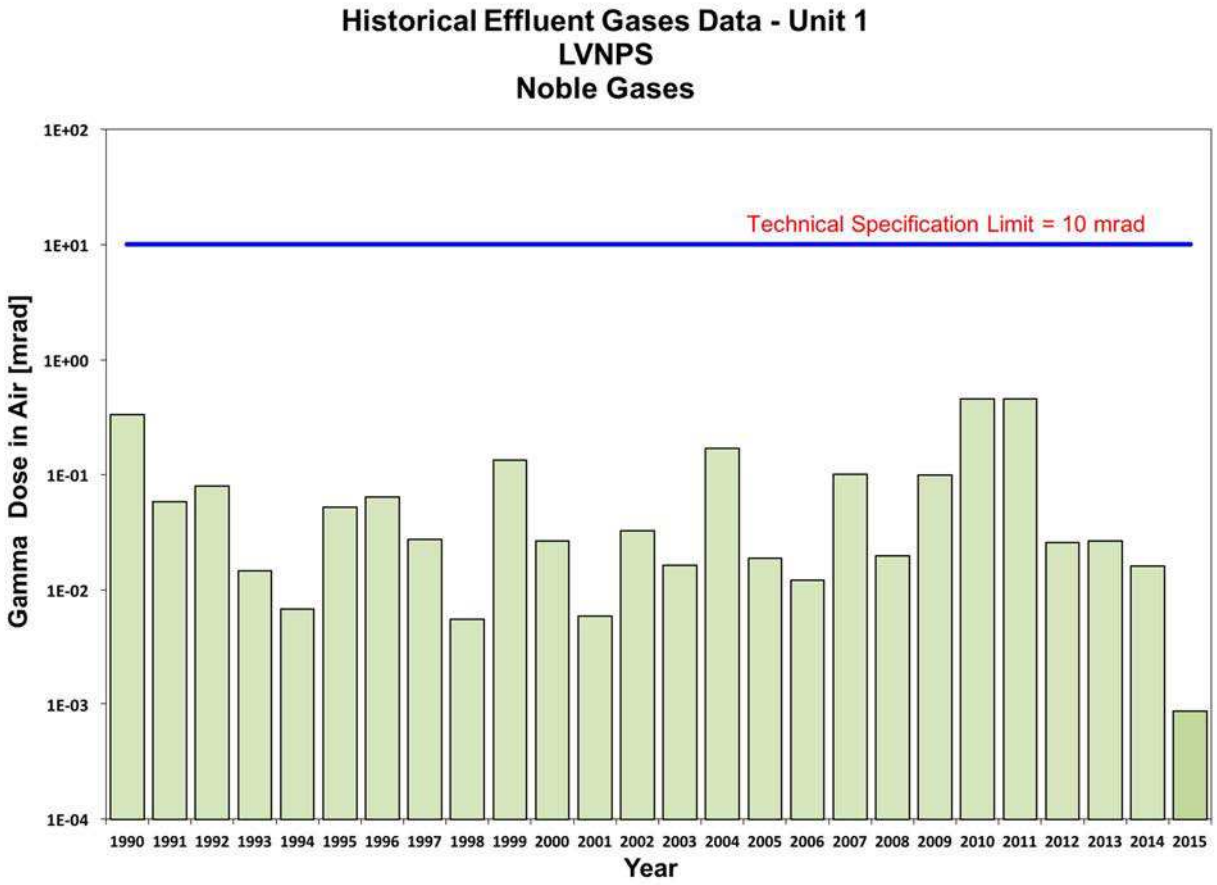

FIGURE 15.7 ANNUAL HISTORICAL DATA OF GASEOUS RELEASES (UNIT 1) - NOBLE GASES

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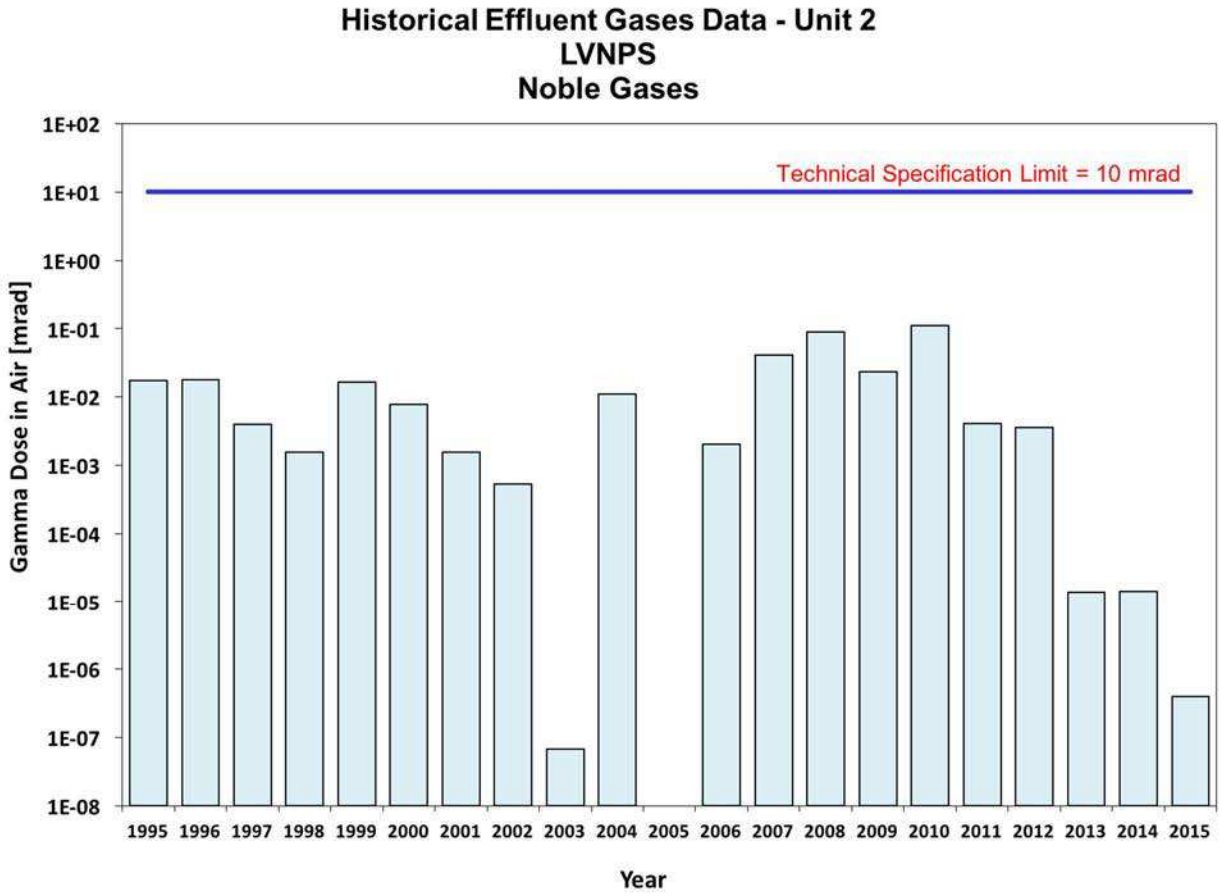

FIGURE 15.8 ANNUAL HISTORICAL DATA OF GASEOUS RELEASES (UNIT 2) - NOBLE GASES

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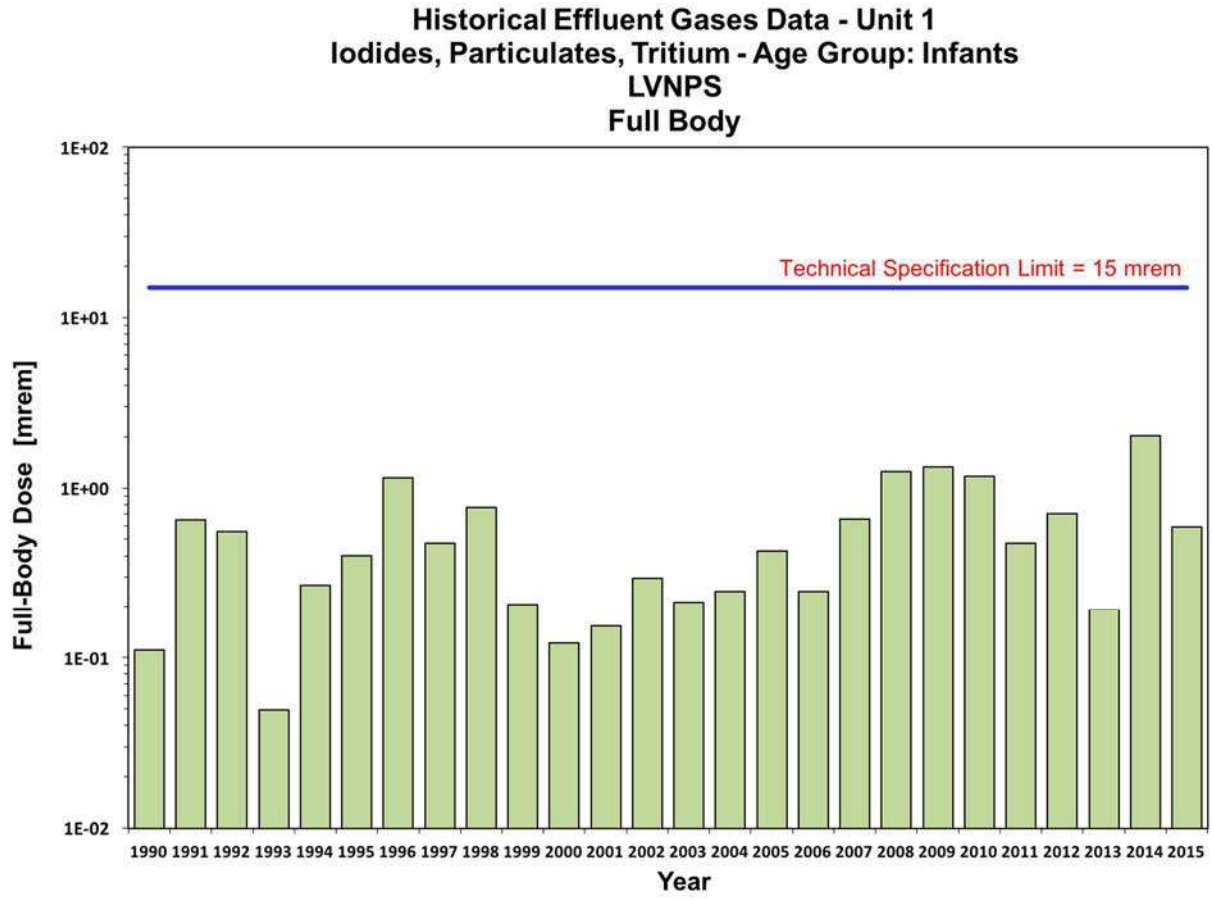

FIGURE 15.9 ANNUAL HISTORICAL DATA OF GASEOUS RELEASES (UNIT 1) – IODIDES, PARTICULATES, AND TRITIUM

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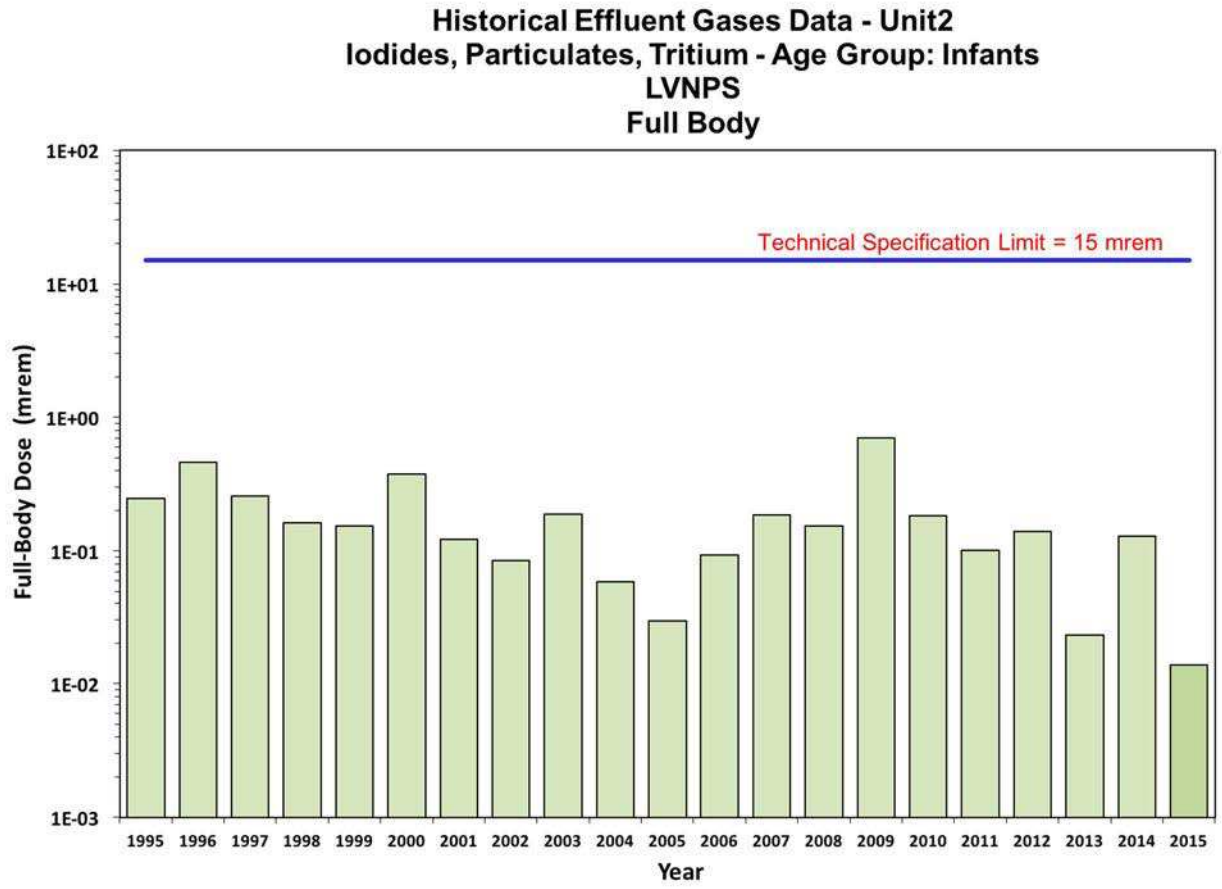

FIGURE 15.10 ANNUAL HISTORICAL DATA OF GASEOUS RELEASES (UNIT 2) – IODIDES, PARTICULATES, AND TRITIUM

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ARTICLE 16. EMERGENCY PREPAREDNESS

Obligations

1. *"Each Contracting Party shall take the appropriate steps to ensure that there are on-site and off-site emergency plans that are routinely tested for nuclear installations and cover the activities to be carried out in the event of an emergency.*

   For any new nuclear facility, such plans shall be prepared and tested before it commences operation above a low power level agreed by the regulatory body.

2. *Each Contracting Party shall take the appropriate steps to ensure that, insofar as they are likely to be affected by a radiological emergency, its own population and the competent authorities of the States in the vicinity of the nuclear facility are provided with appropriate information for emergency planning and response.*

3. *Contracting Parties which do not have a nuclear installation on their territory, insofar as they are likely to be affected in the event of a radiological emergency at a nuclear installation in the vicinity, shall take the appropriate steps for the preparation and testing of emergency plans for their territory that cover the activities to be carried out in the event of such an emergency."*

Article 16 (1) Emergency plans and programmes

- **Overview of the Contracting Party's arrangements and regulatory requirements for on-site (including multi-unit nuclear installations and/or multi-facility sites) and off-site emergency preparedness, including applicable laws not mentioned under Article 7**

  Article 28 of the Nuclear Law states: *"Authorisations for construction and operation of a nuclear installation shall be issued only when it can be demonstrated, by presenting the pertinent information, how safety objectives are to be attained and which procedures and methods will be used during the siting, design, construction, operation, modification, cease of operations, definitive shutdown, and decommissioning. In addition, the corresponding radiological emergency plan shall be presented. Such information should follow the terms and forms stipulated in the regulatory provisions of this Law"*.

  In the same way, Article 50, Section VII, defines CNSNS attributions and responsibilities: *"Prior to the start-up of operations, review, assess and authorise the plans that should be in place for dealing with anomalous or emergency conditions in nuclear and radioactive installations"*.

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The General Regulation on Radiation Safety establishes in a particular manner, in Article 124, that: *"Prior to initiating operations, any radioactive installation must have an Emergency Plan congruent with the National System for Civil Protection guidelines and based on a survey of the radiological consequences of accidents that could occur at the installation"*.

Condition No. 13 of the Licence for Commercial Operation of Laguna Verde Nuclear Power Station (LVNPS) Units 1 and 2 emphasises the necessity to maintain updated radiological emergency plans.

- **Overview and implementation of the main elements of the national plan (and regional plan, if applicable) for emergency preparedness, including the chain of command and roles and responsibilities of the licence holder, the regulatory body, and other main actors, including State organisations**

Introduction

LVNPS's emergency preparedness is composed of two complementary plans, known as the Internal Emergency Plan (IEP, PEI in Spanish) and the External Radiological Emergency Plan (EREP, PERE in Spanish).

Internal Emergency Plan

The Internal Emergency Plan forms part of LVNPS's Integrated Emergency Preparedness, developed by CFE.

The Internal Emergency Plan describes the organisation, resources and directives that will be applied under emergency situations at LVNPS. This organisation fulfils the requirement of the USNRC NUREG- 0654.

There is an essential group called "Technical Support Group" composed of the Coordinator of Emergencies at the Site and four directors (Radiation Control, Evaluation of Accidents, Repairs of Emergency, and Operation Support) supported by two Notifiers of Emergency and an Advisory Group, with task groups for each of the response areas such as: Fire Protection Brigade, Operational Support, Evaluation of Accidents, Chemistry, Dose Projection, Monitoring and Decontamination, Environmental Monitoring, Damage Control, Logistics Support and Security.

Additionally, LVNPS has a Technical Support Centre located in an area adjacent to the Main Control Room (MCR) of each unit, where there are work stations with signals from the Integral Information Process System, which provides safety parameters display and key variables of the operating plant status, and the radiation and environmental status.

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External Radiological Emergency Plan

This plan includes the development of procedures for performing specific tasks that allow gathering of the information needed to make accurate and timely decisions to eliminate or reduce risks to the population. The plan also represents the inter-sectoral coordination and joint action used to rapidly activate the presence of all levels of the government on-site and in the area surrounding the problem.

The radiological emergency response organisation is composed of the federal and state agencies listed below. These entities form the External Radiological Emergency Plan Committee (EREPC):

- Secretariat of the Interior (SEGOB)
  - National Civil Protection System (SINAPROC)
  - National Centre for Prevention of Disasters (CENAPRED)
- Secretariat of Public Safety (SSP)
  - Federal Police (PF)
- Secretariat of Defence (SEDENA)
- Secretariat of the Navy – Army (SM - AR)
- Secretariat of Finance and Public Credit (SHCP)
- Secretariat of the Environment and Natural Resources (SEMARNAT)
  - National Water Commission (CONAGUA)
  - Federal Attorney for Environmental Protection (PROFEPA)
- Secretariat of Energy (SENER)
  - Federal Electricity Commission (CFE)
  - National Commission for Nuclear Safety and Safeguards (CNSNS)
- Secretariat of Communications and Transportation (SCT)
  - Veracruz Centre of the Secretariat of Communications and Transportation
  - Mexican Airspace Navigation Services (SENEAM)
- Secretariat of Health (SS)
- Secretariat of Social Development (SEDESOL)
  - Department of Food Distribution to Remote, Marginalized Areas (DICONSA)

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- State Government of Veracruz (GEV)
  - Secretariat of Civil Protection
  - Secretariat of Health
  - Communications Department

All the entities in the emergency response organisation have a controlled copy of the EREP, which will be updated with modifications or amendments determined by the subcommittees or the task forces, validated by the EREPC Technical Secretary. In addition, the response personnel are trained in accordance with valid procedures and manuals. Verification of the human and material resources is performed following the valid procedures. Information is released to the public based on the corresponding task forces' schedules. The drills are conducted according to the training plan of the corresponding entity, and the exercises included to evaluate the effectiveness of the plan are performed according to CNSNS instructions.

The responsibilities that each organisation must take to keep the plan valid and operational are defined in the EREP. Table 16.1 is a table of responsibilities for the preparation stage, taken from the EREP Manual. The table's column headings are defined above, as part of the EREPC.

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TABLE 16.1 MATRIX OF RESPONSIBILITIES OF THE EREP COMMITTEE DURING THE PREPARATION STAGE

No.	Activity	SEDECO	SEGOB	CFE	SCT	SEDENA	SM-AM	GEV	SS	CONAGUA	PROFEPA	DICONSA	PF	CENAPRED
1	Update plan	X	X	X	X	X	X	X	X	O	O	O	X	O
2	Specialized training	X	X	X	X	X	X	X	X	X	X	X	X	X
3	Public information	O	X	O				X						
4	Population census	O		X				O						
5	Verification of human resources and materials	X	O	O	O	O	O	O	O	O	O	O	O	O
6	Supervised practices, drills, and exercises	X	X	X	X	X	X	X	X	O	O	O	X	O
7	Maintenance of the primary and alternate emergency control centre			X										
8	Maintenance of evacuation routes			O	X			X						
9	Maintenance of vehicle decontamination centres			X										
10	Maintenance of aircraft and armament decontamination centre						X							
11	Maintenance of evacuee monitoring centres			X					X					
12	Maintenance of exposure checkpoints			X					X					
13	Maintenance of temporary shelters							X						
14	Maintenace of vehicles, equipment, and materials required during an emergency		X	X	X	X	X	X	X	X	X	X	X	
15	Maintenance of laboratories			X					X					
16	Maintenance of the communication network			X	O	O	O	O	O	O	O		O	

X: Primary O: Co-responsible

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- **Implementation of related measures**

In order to maintain effectiveness, the EREP includes, as part of its material and human resources and its agreements with state and local authorities, the following:

a) Equipment for radiation monitoring to control the spread of contamination and to determine the type and extent of radioactive deposits in food and water. This equipment allows advance determination of radioactive releases so as to determine which protective actions should be taken.

b) Equipment to immediately notify on-site and off-site IEP and EREP emergency personnel, as well as the state and federal agencies that are part of the EREP.

c) Vehicles and equipment to evacuate on-site personnel and the public from the affected areas.

d) On-site facilities and supplies at LVNPS to decontaminate people on-site.

e) Off-site facilities and supplies (to the north and south of LVNPS) to decontaminate response personnel and evacuees.

f) On-site medical facilities and supplies to provide first aid during an emergency.

g) Off-site medical facilities and supplies (to the north and south of LVNPS) to provide first aid and specialised medical attention to response personnel and evacuees.

h) Arrangements to provide qualified medical staff to handle on-site radiological emergencies.

i) Arrangements to provide qualified medical staff to attend to response personnel during a radiological emergency.

j) Arrangements for transporting injured and contaminated people from the site and from the evacuated areas.

k) Technical support and operations facilities near the site, from where effective management and control can be performed during an emergency.

l) At least one on-site and another off-site communication system, each having its own back-up power system.

m) Arrangements to provide temporary shelters to evacuees.

n) Arrangements for surveillance of the emergency zone, as well as for search and rescue for people possibly affected.

o) Arrangements to provide and control the distribution of water and food required within the zone.

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- **Implementation of emergency preparedness measures by the licence holders**

- **Classification of emergencies**

The EREP describes measures for determining the magnitude of a radioactive material release, as well as its continuous assessment. The plant and instrumentation conditions, in addition to on-site and off-site radiation surveillance, are used to define emergency action levels. The need for notification and participation of local and state authorities are determined using those emergency action levels. When and what kind of personnel and public protective measures are to be used on-site and off-site boundaries are determined based also on the emergency action levels. There are four classes of emergencies defined as follows.

Unusual Event – This class refers to uncommon events in progress or which have occurred, indicating a potential degradation of the plant safety level. In an event of radioactive releases, the value of these exceeds 2 times the Technical Specifications limit for a period greater than 60 minutes, not requiring a response or off-site monitoring, unless degradation of safety systems persists. In this condition only the Internal Emergency Plan is performed.

Alert – This class includes those events in progress or which have occurred involving a real or potential substantial degradation in plant safety level. This class of events requires the EREP activation and defines the beginning of the response actions for the public protection.

On-Site Emergency – This class refers to events in progress or which have occurred involving real or potential major failures of operations necessary for public protection.

General Emergency – This class includes those events in progress or which have occurred involving real or imminent substantial degradation of the core, or melting of the core with potential loss of containment integrity.

LVNPS regulations establish areas around the plant that require protective measures for the population. The resulting Emergency Planning Zone (EPZ) is divided in two:

- Plume Zone – An area with a radius of 16 km surrounding LVNPS's reactors. The area may change based on actual events and NUREG-0654 "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants."

  In the Plume Zone, the primary risk of radiation exposure is via the plume or cloud as it spreads.

  Inside this zone is the Caution Zone, 0 – 5 km radius around the plant.

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- Ingestion Zone – The area where the main means of exposure is through the consumption of surface water and/or contaminated food, and through radioactive material deposited on the ground and in the soil.

Both zones have been divided into geographical sectors of 22.5 degrees, starting with the North sector, which is centred on geographic north, and continuing counterclockwise. The sectors are identified by letter, starting with "A" for the north sector.

To support emergency preparedness activities the following tools are available:

a) Integral Process Information System, that includes the Safety Parameter Display System (SPDS).

b) The computer code known as Radiological Assessment System for Consequences Analysis (RASCAL) developed by Oak Ridge National Laboratory.

c) Methods of core damage estimation based on computer code known as MELCOR (Methods for Estimation of Leakages and Consequences of Releases) developed by Sandia National Laboratory.

d) Events control system for the Control Head.

In addition to these computational tools, the following analytical tools are available, for confirmatory purposes only:

a) Isotopic analysis using Gamma spectrometers.

b) Ionic chromatography.

c) Atomic adsorption.

All systems and equipment mentioned above are available at LVNPS, and trained personnel to operate them are available.

- **Main elements of the on-site and, where applicable, off-site emergency plans for nuclear installations, including availability of adequate resources and authority to effectively manage and mitigate the consequences of an accident**

Internal Emergency Plan

The implementation of the preparedness, response and recovery phases of the Internal Emergency Plan is CFE's responsibility.

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The Internal Emergency Plan is made up of the following facilities:

a) Technical Support Centre.
b) Main Control Room.
c) Emergency Notification Room.
d) Emergency Response Room.
e) Operational Support Centre.
f) Dose Projection Centre.
g) Accident Evaluation Centre.
h) Damage Control Centre.
i) Radiation Control Centre.
j) Medical Assistance Centre.
k) Environmental Surveillance Centre.
l) Alarms Central Station.
m) Decontamination and First Aid Station.
n) Post-Accident Sampling Station.
o) Radiochemical Laboratory
p) LVNPP Laboratory, Chemical Group.
q) Emergency Security Centre.

The IEP also provides for the existence of the following materials and equipment:

a) Personal Protective Equipment.
b) Breathing protective equipment.
c) Radiation monitors.
d) Contamination monitors.
e) High volume air monitoring.
f) Electronic dosimeters and Thermo Luminescent Dosimeters (TLDs)
g) Primary and alternate communication systems.
h) Plant alarm systems (fire, emergency and evacuation)
i) Intensive-care medical unit.

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j) Fire rescue unit.

k) Environmental surveillance unit.

l) Buses for personnel transportation.

m) Potassium iodine for radiation prophylaxis.

External Radiological Emergency Plan

The External Radiological Emergency Plan is a responsibility shared by several Federal and State of Veracruz agencies which form the External Radiological Emergency Plan Committee. The entities that participate are: Federal Electricity Commission, Secretariat of the Interior, Secretariat of Defence, Secretariat of the Navy, Secretariat of Communications and Transportation, Federal Police, Secretariat of Civil Protection for the State of Veracruz, Secretariat of Health for the State of Veracruz, Federal Attorney for Environmental Protection, National Water Commission, and the Department of Food Distribution.

- **Facilities provided by the licence holder for emergency preparedness**

The responsibilities of each agency are defined in the EREP Manual and in its procedures for each phase of the plan: preparedness, response and recovery.

Facilities that make up the External Radiological Emergency Plan are the following:

Operated and maintained by CFE:

a) Main Emergency Control Centre.

b) Alternate Emergency Control Centre.

c) Equipment and Vehicles Decontamination Centre – North.

d) Equipment and vehicles decontamination centre – South.

e) Monitoring Centre for Evacuees – North.

f) Monitoring Centre for Evacuees – South.

g) Exposure Control Post – North.

h) Exposure Control Post – South.

i) Exposure Control of Main Emergency Control Centre.

j) Evacuation Routes within Plume Zone (over 130 km of paved roads)

k) Environmental Engineering Laboratory (TLD reading and sampling analysis)

l) Back-bone Communications Network including Central and Repeater Stations.

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Operated and maintained by other institutions:

a) Temporal shelters.
b) Hospital of Specialised Medical Assistance.
c) State (of Veracruz) Health Laboratory.
d) Aircraft Decontamination Centre.
e) Hospitals for general medical assistance.

The EREP also provides for the existence of the following materials and equipment:

a) Personal protective clothes.
b) Breathing protective equipment (masks and filters).
c) Radiation detection monitors.
d) Contamination detection monitors.
e) High volume air monitors.
f) Electronic dosimeters and TLDs.
g) Primary and alternate communication systems.
h) Ambulances.
i) Vehicles to notify the population.
j) Tow trucks to clear evacuation routes.
k) Buses for personnel transportation
l) Potassium iodine for radiation prophylaxis

- **Training and exercises, evaluation activities and main results of performed exercises, including lessons learned**

The training related to emergency plans and programmes given to LVNPS personnel is valid for a year and is divided into the Internal Emergency Plan and the External Radiological Emergency Plan.

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Training for personnel involved in the Internal Emergency Plan

The nearly 700 LVNPS employees who have assigned duties in the Internal Emergency Plan receive continuing training every year. The following table shows the number of courses attended, depending upon the tasks the staff is involved.

Training (courses)	Year					
	2010	2011	2012	2013	2014	2015
Physical security	6	5	5	5	5	4
Chemical	6	7	6	6	7	7
Damage control	19	20	20	18	16	4
Operation Support Group – Non-Licencable	7	8	10	8	7	7
Accident evaluation	4	6	5	5	6	3 or 4
Unit Monitoring and Decontamination	6	7	6	6	6	6
Dose Projection	3	4	4	4	4	1
On-site Environmental Monitoring	3	3	3	3	3	4
Medical	4	3	4	3	3	2
Notifiers	5	4	6	6	7	8
Technical Support	1	1	1	1	1	1
Operation Support Group – Licencable	16	16	16	16	16	18
Logistics Support (Warehouse)	4	5	5	3	0	1

Training for personnel involved in the External Radiological Emergency Plan

The nearly 315 LVNPS employees who have assigned duties in the External Radiological Emergency Plan receive continuing training every year. The following table shows the number of courses attended, depending upon the tasks the staff is involved.

Training (courses)	Year		
	2013	2014	2015
Evacuee Monitoring Centre	7	8	8
Vehicle Decontamination Centre	8	6	5
Exposure Control	1	1	1
Notification	2	3	2
Services	2	1	1
Dose Calculation	3	6	1

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Training (courses)	Year		
	2013	2014	2015
Technical Analysis	1	1	1
Monitoring and Decontamination Techniques	0	0	0
Mobile Decontamination Unit	N/A	N/A	N/A
CFE's Task Force Coordination	1	1	0
Logistics Support	1	1	1
Environmental Surveillance	2	1	1
Emergency Plans for EREP Coordinators (via NEI)	1	1	1
On-site Count	8	3	4
Transportation	2	2	2
Laboratory	2	1	1
Notification and Decontamination	0	1	0
Accident and Protection Actions Evaluation	1	0	1
Communication and Information Technology	1	1	1
Notification Network	1	1	1
Primary Operation Network	1	1	1
Emergency Infrastructure and Facilities and Evacuation Routes	1	0	1
Information Technology Task Units	1	1	1
Financial Management	1	1	1
Supply	2	1	1
Advisory Group	1	1	1

Additionally, CFE supports the training of staff from the different federal and state agencies participating in the EREP. Participants attend training delivered by LVNPS at CFE facilities (for example, the Federal Attorney for Environmental Protection personnel attended the course "Monitoring and Decontamination Techniques"), or CFE's instructors give the courses at other agency's facilities (for classes including Instructor's Training on EREP, Use of Communications Equipment, Emergency Plan, LVNPS Nuclear Technology, and Radiation Monitoring).

Internal Emergency Plan exercises and drills

During the 2013-2015 period, several Internal Emergency Plan drills were conducted to verify the facilities and equipment readiness, and the staff training. The number of drills for each area per year is summarised in the following table.

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Area	Year					
	2010	2011	2012	2013	2014	2015
Emergency notification	4	4	4	4	4	4
Fire protection	*	*	*	*	*	*
First aid	1	1	1	1	1	1
Monitoring and decontamination	5	4	4	5	4	4
Environmental surveillance	1	1	1	1	1	1
Dose projection	2	2	2	2	2	2
Post-accident sampling	4	4	4	4	4	4
Accident evaluation (plant condition and situation)	2	2	2	2	2	2
PEI-FT-82	1	1	1	1	1	1
Damage control	2	2	2	2	2	2
Accounting and evacuation	1	1	1	1	1	1
Severe storm	2	2	2	2	2	2

* Industrial Safety conducts this drill since 2010.

External Radiological Emergency Plan exercises and drills

During the 2013-2015 period, several External Radiological Emergency Plan drills were conducted to verify the facilities and equipment readiness, and the staff training. The number of drills for each area per year is summarised in the following table.

Area	Year		
	2013	2014	2015
Notification to Control Head	4	--	5
Evacuee monitoring, classification and decontamination	3	--	8
Equipment and Vehicles Monitoring and Decontamination	3	--	5
Off-site Environmental Surveillance	1	--	1
Exposure Control and Laboratory	2	--	2
Dose Calculation	0	--	1
Accident and Protection Actions Evaluation and Technical Analysis	0	--	1
Communications	0	--	1
Logistics Support	0	--	0
IEP / EREP Desk Exercises	1	--	2
On-site count, transportation and evacuation of Convening Centres	1	--	1
Total	15	--	27

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An Integrated Exercise was performed on July 18, 2014. All members of the EREP participated, and the exercise was evaluated by CNSNS. The primary purpose of the exercise was to test the performance of staff in the activities of shift changes, activation of the Alternate Emergency Control Centre in the Engineering Subdivision at the offices in Dos Bocas, Veracruz, and the transfer of responsibility from the Emergency Control Centre to the Alternate Emergency Control Centre.

Evaluation activities

Training on emergency planning has two delivery methods as mentioned above. Theoretical training (classroom training) and practical training (field drills). The training evaluation is done as follows.

a) Theoretical training

At the end of the training session, the trainees take a written examination to demonstrate that the necessary knowledge to carry out the activity that they have assigned in the Emergency Response Organisation was acquired and/or reinforced.

b) Practical training

This training is done in two stages. The first is a "supervised practice," during which trainees (staff) perform an activity based on a planned scenario, making use of the resources available to them. The training supervisor can stop the activity to make observations and to show how the function should be performed.

In the second stage, carried out without the supervisor, the trainees are required to perform an activity, one that is part of the emergency plan, for an accident scenario that is unknown to them until the session begins. They need to use all available material resources to perform the activity, and each trainee is evaluated according to his or her performance, which must be in adherence with procedures and the operations manual, specifically taking into account the critical steps to satisfactorily perform the activity.

Both the theoretical and practical training are evaluated following the procedures PE-7193 and PERE-214 guidelines.

Main results

During the 2013-2015 period, the following emergency plans improvements were made.

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a) External Radiological Emergency Plan

i. Logistical planning of shift changes during a drill or real emergency, based on the time of the initial response.

ii. Logistical planning of relief groups during a drill or real emergency.

b) Internal Emergency Plan

i. Design of IEP health indicators. Eight indicators that reflect different aspects of the health of the IEP were designed. They have identified areas in need of attention, generating action plans for improving key elements.

ii. Participation in the Performance Improvement Committee. Currently participating in the Performance Improvement Committee to communicate the issues that impact the performance of the IEP.

iii. Inclusion of Critical Tasks in the training and drills processes. 180 critical tasks, applicable to the IEP response, were identified. These tasks must be demonstrated in the Emergency Response Organisation and be incorporated in procedure PE-7193 "Training, Exercises, and Drills." This has allowed performance during drills to be observed, and training plans have been implemented to correct errors.

iv. Process of deviating from normal work conditions. The process was included in the Operations Support procedure (PE-7082). It allows continuation of emergency response activities, raising awareness of administrative controls that can't exist in these conditions. Additionally, the process requires that various Emergency Response Organisation teams – Damage Control, Chemistry, Unit Monitoring and Decontamination, and Operational Support – to take compensatory actions in the absence of administrative and physical controls for entry of response personnel to LVNPS units during an emergency.

v. Process of acquiring emergency materials. Improvements were identified through evaluation of critical tasks previously introduced in the IEP. CFE's manual for contingency management was taken into account, as was the participation of Supply and Warehouse. The process has been disseminated to appropriate staff and has contributed to strengthening administration's perception of the IEP and the importance of related activities.

vi. Implemented improvements from PE-7071 "On-Site Emergency Coordinator" and PE-7101 "Emergency Notifier." The improvements include clarifying the responsibility of the on-site emergency coordinator regarding recommending and carrying out actions to protect on-site and off-site personnel, as well as to align the notification process.

vii. Actual measurements, during drills, of the Declarations, Notifications, and Protective Actions. Allows the IEP Coordination Team to be involved in the monitoring and measuring of declarations during drills, using this platform as a

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direct measure of performance of licenced operation personnel during emergency plan drills. It also allows testing of the relationship between the interim On-Site Emergency Coordinator and the interim Emergency Notifier, ensuring that the three most important critical tasks of the emergency plan (Declarations, Notifications, and Protective Actions) are performed properly and that the modifications made in the procedures (PE-7071 and PE-7101) are appropriate.

viii. Replication of the Technical Support Centre during drills. This shows the critical work of key Emergency Response Organisation teams – Technical Support, Accident Evaluation, Dose Projection, and operational personnel – as well as enhances the realism of the drills, permitting direct interaction with dynamic parameters displayed in the Safety Parameters Display System (SPDS). The Technical Support Centre includes a communications system, software, and the SPDS, as well as the plant's technical support centre.

- **Regulatory review and control activities**

Internal Emergency Plan

According to the Baseline Inspection Programme, CNSNS annually carries out an inspection to the Internal Emergency Plan to verify the following:

a) The changes made to the Emergency Response Organisation.

b) The independent reviews and audits, and the internal reviews and audits conducted to the Internal Emergency Plan.

c) The alert and notification system.

d) The method for increasing the Emergency Response Organisation personnel.

e) The changes to the emergency action levels and the Internal Emergency Plan.

f) The effectiveness in identifying and correcting weaknesses and deficiencies.

g) The drills programme and the assessment of the drills performed.

h) The facilities and equipment.

i) Emergency Response Organisation member training.

Moreover, CNSNS's inspectors ask LVNPS staff to perform exercises, to witness compliance with the Internal Emergency Plan applicable regulation.

As a result of these inspections, CNSNS found the following:

a) Delay in implementing public announcement system improvements.

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b) Weaknesses of the Emergency Response Organisation members in drills participation.

c) Improvements in external communications through the use of satellite telephones.

External Radiological Emergency Plan

CNSNS's control and assessment of the External Radiological Emergency Plan have been implemented through a documental review, a field inspection of the EREP's task forces and the execution of exercises for the EREP activities.

In 2014, at the request of the National Civil Protection Agency, CNSNS conducted an integrated exercise with the purpose of determining the suitability of the EREP. 50 issues were identified that represent a risk to the population during response to a general emergency at LVNPS. Based on that input, the various task forces of the EREP are working to complete modifications and pertinent training prior to the integrated exercise planned for 2016.

- **International arrangements, including those with neighbouring States, as necessary.**

See Annexes 7.1 and 7.2.

Article 16 (2) Information to the public and neighbouring states

- **Overview of Contracting Party's arrangements for informing the public in the vicinity of the nuclear installations about emergency planning and emergency situations**

One of the key factors for a successful implementation of the measures to protect the population living in a radius of up to 16 km from LVNPS is the information regarding their participation in the event of a radiological emergency.

The main information media are the following:

a) The EREP calendar, which is distributed in all homes and businesses located in a radius of up to 16 km from LVNPS. The calendar has information on actions to be completed by the population in case of an emergency. This information is delivered to about 4,000 households.

b) Visits of communities to the LVNPS Information Centre. The Information Centre makes the invitation and provides transportation for the community groups. The communities have the opportunity to go to the centre and receive information about the External Radiological Emergency Plan. This programme received about 300 people per year.

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c) Visits to schools around LVNPS. Over the past three years, information about LVNPS and the EREP has been shared with more than 1,700 students.

- **Arrangements to inform competent authorities of neighbouring States, as necessary**

Since 1988, Mexico has been a part of the "Convention on Early Notification of a Nuclear Accident" and the "Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency." Based on these conventions, there is an established procedure to declare a radiological emergency at a Mexican nuclear installation if an event has the likelihood of affecting neighbouring states. The procedure's objective, to provide early notification, and its application are the responsibility of CNSNS. Notwithstanding the preceding, Mexico has bilateral agreements for exchange of technical information (including the occurrence of significant events) with their closest neighbours.

Mexico is also part of the IAEA Early Communications International System, which would be used to immediately provide information to the IAEA in the event of a radiological emergency at LVNPS. The same information would be available to neighbouring states. Mexico is also a signatory of the "Vienna Convention on Civil Liability for Nuclear Damage". It is important to mention that the LVNPS site is over 500 km away the border of the nearest country.

Mexico has a National System for Civil Protection. In the event of a radiological emergency at a nuclear installation in Unites States of America, near the border with Mexico, with likelihood to affect the national territory, the DN-III Plan would be activated. The Ministry of Defence is responsible to apply the DN-III Plan under the direction of the Secretariat of the Interior, assisted by the Secretariat of Health and DICONSA. The DN-III Plan includes the infrastructure required to establish adequate communications, evacuation capacity and establishment of control points for taking the appropriate actions during the emergency. However, it should be noted that the United States nuclear power plants are sited more than 100 km from the Mexico's border and other Central American countries such, as Guatemala, do not have this kind of power stations.

Article 16 (3) Emergency preparedness for Contracting Parties without nuclear installations

Not applicable for Mexico.

Related to the Event at Japan's Fukushima Daiichi Plant

In connection with the even that occurred at the Fukushima Daiichi plant in Japan on March 11, 2011, and in compliance with the instructions included in the "Technical Points to be

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Considered" section of CNS/ExM/2012/12 Rev. 1 ("Chairman's Report of the Special Meeting, Second Special Meeting of the Contracting Parties to the Convention on Nuclear Safety", August 2012, Annexe III, Paragraph 23), also described in the minutes (point 2.b) of the "6th Board Officers Review Meeting" of the Convention on Nuclear Safety, held on October 29, 2012, the following is reported:

Emergency preparedness and response improvements

1) Multiple-unit sites

LVNPS will implement strategies to improve the response capacity to cope with situations that arise from extreme natural events. The implementation starts assuming that the event simultaneously affects both LVNPS units, which must have response capacity without depending on a common system and/or equipment.

3) Additional responsibilities of government agencies

As mentioned before in this Article 16, with regard to the External Radiological Emergency Plan, the Emergency Response Organisation is formed by the federal and state agencies listed previously, which form the External Radiological Emergency Plan Committee.

2) New procedures

Once the mitigation strategies are implemented and tested, the emergency management procedures will be reviewed and updated. Depending on each strategy purpose, it will be defined if the strategy is incorporated to the normal operation procedures, the Emergency Operating Procedures (EOPs), the severe accident procedures, and/or new procedures and guidelines are developed to cope with situations that arise from extreme natural events.

5) Joint actions with various agencies and improvements in international cooperation

Mexico, through CNSNS, participates in the Organisation for Economic Co-operation and Development's (OECD) Nuclear Energy Agency (NEA) Senior Task Force on the "Impact of the Fukushima Daiichi Nuclear Plant Accident".

CNSNS is also member of the Ibero-American Forum of Radiological and Nuclear Regulatory Agencies (FORO in Spanish), which has developed as one of its tasks, stress tests for nuclear power plants. The tests are similar to the ones defined by the European Nuclear Safety Regulators Group (ESREG) and the Western European Nuclear Regulators Association (WENRA).

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How the IAEA safety standards are taken into account

As mentioned in Article 7 (1), Mexico has committed to implement the safety and health protection measures, as stated in the Informative Circular No. 18/Rev.1, by subscribing an agreement with the International Atomic Energy Agency whereby the Agency would assist in the implementation of a project for a nuclear power plant. Thus, Mexico applies and is obliged to comply with the IAEA´s Basic Safety Standards.

Actions committed to for improving openness and transparency with stakeholders

As mentioned in the Introduction, this report and the previous ones are public documents in compliance with Mexico's "Federal Law of Transparency and Access to Government Public Information," which came into force on June 12, 2002, and the "General Law of Transparency and Access to Public Information," which came into force on May 5, 2015, as well as the recommendations from the Convention contained in INFCIRC/572/Rev. 5, dated January 16, 2015.

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ARTICLE 17. SITING

Obligations

"Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented:

i) for evaluating all relevant site-related factors likely to affect the safety of a nuclear installation for its projected lifetime;

ii) for assessing the likely safety impact of a proposed nuclear installation on individuals, society and the environment;

iii) for re-assessing as necessary all relevant factors referred to in sub-paragraphs (i) and (ii) so as to ensure the continued safety acceptability of the nuclear installation;

iv) for consulting Contracting Parties in the vicinity of a proposed nuclear installation, insofar as they are likely to be affected by that installation and, upon request providing the necessary information to such Contracting Parties, in order to enable them to evaluate and make their own assessment of the likely safety impact on their own territory of the nuclear installation."

Article 17 (1) Evaluation of site related factors

- **Overview of the Contracting Party's arrangements and regulatory requirements relating to the siting and evaluation of sites of nuclear installations, including applicable national laws not mentioned under Article 7 of the Convention**

Prior to granting the construction permit, the licence holder of Laguna Verde Nuclear Power Station (LVNPS) provided information to the competent authority for authorisation of the location of the site where the construction was to initiate; even though the Nuclear Law is posterior to the initiation of the construction work, the regulatory standards to approve this stage of the installation were 10 CFR 100 and 10 CFR 50 Appendix A. The following United States Nuclear Regulatory Commission (USNRC) Regulatory Guides (RG) were added as soon as edited:

a) RG 1.29, defining seismic design classification.

b) RG 1.59, related to design basis for flooding.

c) RG 1.60 defining seismic design response spectrum.

d) RG 1.61 establishing seismic design damping values.

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e) RG 1.70 on safety report standard forms and contents.

f) RG 1.76 on design basis tornado.

g) RG 1.91 considering human activities nearby nuclear installations, defining explosion characteristics occurring within the vicinity of the plant.

h) RG 1.102 on protection against floods.

i) RG 1.111 on radioactive effluent dispersion.

j) RG 1.132 on foundation investigations.

k) RG 4.2 on environmental impact reports.

Also, the USNRC Regulatory Guide 1.165, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion" was used in 1999 to assess the changes to the Technical Specifications (TS).

- **Overview of assessments made and criteria applied for evaluating all site related factors affecting the safety of the nuclear installation, including multi-unit failure, loss of infrastructure, and site access following an event**

The main objective of assessing the location of nuclear installations from the nuclear safety standpoint is to protect the public and the environment from the radiological consequences of radioactive releases due to accidents. The assessment must also take into account the emissions caused by normal operation of the installation. The suitability assessment of a site to build a nuclear installation must take into consideration the following aspects:

1. The effects of external events that take place in the region where the site is located (these events can be natural or man-made);
2. The site and the characteristics of its surrounding that could influence the exposure of humans and the environment to emissions of radioactive materials;
3. The population density and distribution, and other off-premise characteristics insofar as they are likely to prevent applying emergency measures and assessing the risks to individuals and the population.

Additionally, as a result of the Fukushima Daiichi accident, CNSNS required CFE to comply with 10 CFR 50.54(hh)(2), following the guidelines of NEI 06-12 Rev. 2, to address beyond-design-basis accidents. Currently, CFE is implementing diverse and flexible coping strategies (FLEX), as described in NEI 12-06 Rev. 1, as well as NEI 12-02 Rev. 1 and NEI 13-02 Rev. 1 (see Articles 6 and 18).

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- **Overview of design provisions used against human made external events and natural occurring external events such as fire, explosion, aircraft crash, external flooding, severe weather conditions and earthquakes and the impact of related sequential natural external events (e.g., tsunami caused by an earthquake, mud slide caused by heavy rain)**

LVNPS Units 1 and 2 siting design basis

After performing an analysis, with technical assistance of experts from the International Atomic Energy Agency (IAEA) in 1968, on the different sites proposed, it was decided that the site with suitable seismic, accessibility, cooling water supply, demographic and location characteristics was the place located on geographic co-ordinates UTM Latitude 19° 43' 30" North and Longitude 96° 23' 15" West, in the State of Veracruz.

Once the preliminary selection was made, detailed studies were initiated, considering Geography, Demography, Meteorology, Hydrology, Geology, Geotectonic, and Seismicity as well as the impact these would have on the installations, occurrence of diverse weathering and man-made activities.

This information was provided as part of the Preliminary Safety Analysis Report (PSAR), later updated in the Final Safety Analysis Report (FSAR) and submitted to CNSNS as a support of the original application for a Licence for Commercial Operation for LVNPS Units 1 and 2. CNSNS also requested the delivery of a Final Environmental Impact Report (FEIR) in addition to the information presented in the Final Safety Analysis Report.

Main site characteristics (Geography and Demography, Impact of Industrial Installations and Geology, Seismology and Geotectonic Engineering) used in defining design basis related to LVNPS Units 1 and 2 siting are briefly identified below.

Geography and Demography

The demography analysis performed took into account population growth perspectives, zones of its influence and changes in the land uses up to the year 2020. Areas of property over which CFE has authority were defined exactly as required by the applicable standards, for instance the Restricted Area, Controlled Area and Exclusion Area.

There are no high-density population areas within a vicinity of 10 km from LVNPS and there is only one settlement of 5 inhabitants within a radio of 2 km from the plant. The low population area, as defined in 10 CFR 100, consists of an area of a radius of 16 km from the site. Population projected within this zone for the year 2020 is approximately 34,530 inhabitants, being considered a low density population. Population centres of over more than 20,000 inhabitants within an area of 70 km radius from LVNPS are:

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City	Population	Distance from site (km)	Direction
Coatepec	86,696	65.6	WSW
Xalapa	497,928	57.5	WSW
Veracruz and surrounding suburbs	552,156	70.0	SSE

Impact of industrial transportation and military facilities nearby the site

There are no military, chemical or manufacturing industries, airport or chemical storage facilities within a radius of 8 km from the site which could potentially affect the operation of LVNPS Units 1 and 2.

The most important route of transportation within a radius of 10 km is Federal Road No. 180 running North to South and located 2 km East from the site. This road serves as the means of access to LVNPS and has a vehicle flow of less than 3,000 vehicles per day.

The nearest commercial railway is located at 40 km from the site and there is a private industrial railway extension 15 km from the site, which is rarely used.

The nearest airport is located 70 km south of Laguna Verde, in the city of Veracruz. The main runway is 2,500 m long and 45 m wide.

A maritime route between Veracruz and Tampico passes in front of the site at an approximate distance of 83 km. In addition, small fishing boats operate over 5 km away from Laguna Verde's coast. The design of the intake structure of LVNPS Units 1 and 2 considers breakwaters to protect it from any impact produced by this kind of boats.

A 7.5 cm diameter oil piping and another 121 cm diameter piping for natural gas, property of the Mexican Oil Company (hereinafter called "PEMEX") pass by LVNPS' installations (Reactor Building) at approximately 1,200 m.

As part of the assessment of the impact of facilities within the vicinity of LVNPS Units 1 and 2, the following events were analysed:

Explosions

a) Due to the distance between the road and maritime routes, and LVNPS, no event postulated on such routes represents a credible risk for structures important to safety, since their effects are covered by considerations for a design-basis earthquake, design-basis tornado and design-basis hurricane.

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b) Postulation of gas pipe line incidents were analysed in regards to explosion and thermal load through ignition of leaked gas. The results of the analysis show both that the pressure peak caused as well as the thermal load produced by explosion are less than the design-basis hurricane and thermal design of the structures.

c) An event of particular interest for CNSNS was the mining project “Caballo Blanco". The exploration phase of the project was performed in 2011. The mine is located 3.5 km away from LVNPS, outside its property. Two controlled blasts were carried out, which induced particle accelerations and velocities below the LVNPS Operating Basis Earthquake (OBE) and the allowable limits in United States of America (US) Bureau of Mines Bulletins 442 and 656, as well as other international standards. The maximum acceleration produced by both explosions was 0.0025 g, which is less than the 0.14 g OBE. This project was cancelled at the end of 2012 by the Secretariat of the Environment and Natural Resources (SEMARNAT).

Toxic chemicals

No important amounts of toxic chemicals are used or stored within the vicinity (8 km) of LVNPS.

Fires

There are not any external installations within the vicinity of LVNPS, which could lead to producing fire conditions.

Therefore, considering the above-cited information, it is observed that there are not any installations within the vicinity which may be considered as a basis for the design of LVNPS.

The design of Structures, Systems and Components (SSC) for LVNPS Units 1 and 2 was based upon normal and extreme meteorological and hydrological conditions, which could hypothetically appear at site. This includes the consideration of maximum sustained winds, tornado winds, effects from a Probable Maximum Hurricane (PMH), probable maximum flood and seiche, surge and tsunami wave effects. Furthermore, and in a conservative manner, structures important to safety have been analysed against stresses resulting from an elevated 3 m high flood above the installation’s foundation elevation.

Geology, Seismology and Geotechnic Engineering

LVNPS siting is located at the intersection of parallel 20 and the Trans-Mexican Volcanic Belt (TMVB). This belt is an East-West trending belt of volcanic vents and volcanic units that extends from the Pacific coast north of “Puerto Vallarta” to the area of the LVNPS site on the Gulf of Mexico. The TMVB is the indirect result of the subduction of the oceanic Cocos Plate sliding beneath continental plate Mexico from the Central America Trench along the

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Pacific Coast of southern Mexico. The subducted slab of the Cocos Plate melts at depths of about 100 km, producing magma that rises to form the volcanoes and related magma bodies of the TMVB.

Heat flow measurements suggest that the TMVB typically have a thin brittle crust with the remaining crust below being typically plastic. This thin brittle crust cannot store great strain energy, which explains why the TMVB is located in an area of relatively low seismicity, and that the damaging earthquakes that have occurred within the TMVB have not approached in magnitude to the great earthquakes typical of the Benioff Zone.

LVNPS's siting is located in the Trans-Mexican Volcanic Belt, close to the eastern border of the province. The installation is founded on a mass of Pliocene-Pleistocene basaltic rocks running along the Gulf of Mexico over an approximate 1.4 km extension of a variable 30 to 50 m thickness. Stratigraphic studies show the existence of a subjacent layer of alluvium consolidated deposits of a 40 to 65 m thickness deposited over andesitic material, extending itself 150 m in depth. The basaltic layer presents a columnar fracture of thermal nature of lengths going from 6 to 8 m.

In order to satisfy the regulatory requirements, CFE performed the following studies: Physiography, Geological History, Differential Settlements and Upheavals, Stratigraphy, Faulting, Chemical Weathering, Cavernous and Carstic Terrain, Subsoil Faults Under Dynamic Load, Pre-consolidation Evidence by Volcanic Erosional Processes, Liquefaction, Slope Stability, Permeability and Water Table, Seismic Stability of Alluvium Materials subjacent to Superficial Basalt and Flow of Ashes and Lava from a Potential Volcano Eruption.

Because of the proximity of the site to different volcanoes of the eastern TMVB, the near field effects (ash fall and lava) at "El Abra" and the far field effects eruption at "Pico de Orizaba" were analysed. Due to the geologic characteristics, morphology of the cone and crater, other kinds of possible effects were not considered possible. There is not any evidence to associate the cinder cones at "El Abra" with historic macro-seismicity.

In this specialty, the atmospheric shock waves induced by explosions were also considered.

The following regional studies were performed covering a radius of 320 km: Volcanic activity, Superficial faulting, Tsunami and Tectonic of sea bed, Attenuation of vibratory movements of Trans-Mexican Volcanic Belt ground, Tectonic provinces and maximum historically-related earthquakes, Acelerograms, Determination of Design Basis and Operation Basis Earthquakes, Geological-Seismic conditions on continental platform and Sea bed boundary, Correlation of regional seismicity with site seismicity, Structural relations between "Graben", "Palma Sola", "Cofre de Perote" and "El Farallon", Related tectonics; Analysis of two faults parallel to volcanic cones of "El Abra", Related tectonics; Distribution of mine fracture systems and the zone of "La Viga-Tuxtla" as well as distinction fracture system of "El Abra", Tectonics related.

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The seismic design basis for LVNPS was defined using the Peak Ground Accelerations (PGAs) that were computed for the maximum earthquakes identified for each seismotectonic province and similarly for each of the potential seismogenic structures that were identified within the Trans Mexican Volcanic Belt.

Peak Ground Accelerations were computed using six different formulas that appear in common literature (Campbell, Joyner and Boore, Idriss, Bufaliza, Esteva and Villaverde, and Esteva conservative).

The response spectrum for the Safe Shutdown Earthquake (SSE) was obtained using the criteria of the USNRC Regulatory Guide 1.60 and, the value of 0.26 g for the safe shutdown peak acceleration was determined. The return period for the SSE is 2,000 years. From this value it was obtained 0.14 g for the Operating Basis Earthquake (OBE) that corresponds to nearly a half of the SSE.

These seismic design parameters for LVNPS were originally developed from a conservative assessment of the potential for earthquakes in eastern continental Mexico and the adjacent area of the Gulf of Mexico and were based on a 1979 site specific studies regarding site ground motion characteristics. Subsequently CFE undertook a series of geological, geophysical, seismological investigations to better evaluate the potential for earthquake induced ground motion at the site. The results of these studies confirmed the conservatism of the original design parameters and did not suggest the necessity for changes in the original design criteria.

These last studies were issued in 1987 and performed taking into account a large amount of data coming from different sources: PEMEX, the US Geological Survey, the Texas University, and the Texas A & M University. These studies not only confirmed the original design ground acceleration and potential for an earthquake, but they strongly indicate that a lower ground acceleration motion could be proposed to CNSNS. The original and current ground motion is 0.26 g and the after mentioned studies suggest an acceleration of 0.18 g. As part of the Periodic Safety Review (PSR) process, performed back in 1999, the above was confirmed and currently CFE is carrying out a Probabilistic Safety Analysis (PSA) of External Events which considers seismic events.

Particularly, in relation to the volcanic risk and as an example of the detail and deepness of the studies performed, both active and non-active volcanoes within a radius of 150 km from the site, including those corresponding to the sea bed, were analysed. In order to provide conservative results of the effect of a volcano eruption, the following was considered as an analysis basis event:

1. The birth of a new volcano 13.5 km away from the site in direction of the ash volcanoes "El Abra", producing quantities of ash and lava equivalent to the known data for volcano “El Paricutin”, and

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2. The eruption of "Pico de Orizaba", considering the amount of ash expulsed equivalent to that of Mount St. Helens in the United States of America on May 18, 1980.

Results determined that the effect of a nearby ("El Abra") or so far ("Pico de Orizaba") volcano eruption would not affect the safe condition of LVNPS Units 1 and 2.

In regards to the impact of sequential external natural events (tsunami caused by an earthquake, mudslide caused by heavy rains), CFE is implementing diverse and flexible coping strategies (FLEX), as described in NEI 12-06 Rev. 1, as well as NEI 12-02 Rev. 1 and NEI 13-02 Rev. 1 (see Articles 6 and 18)

- **Regulatory review and control activities**

CNSNS assessed the FSAR provided by the licence applicant to ensure that the report includes on-site and off-site characteristics and an analysis of relevant accidents. Compliance with the site-related regulations presented in Article 17 (1) was also assessed. The physical characteristics and the man-made risks assessed are presented below.

Earthquakes

The seismic and geological conditions of the region, and the geological and geotechnical engineering aspects of the site area were assessed. Additionally, information on historical earthquakes and the earthquakes recorded by the instrumentation of the region was collected and documented, in order to determine the earthquakes associated risks through regional seismotectonic assessments.

Superficial faults

An assessment was made to determine if there were superficial faults in the site´s vicinity and the probability that earthquakes could have been caused by them.

Volcanoes

The existence of volcanoes in the site's vicinity and the effects they would have on the installation safety were assessed.

Hurricanes and tornadoes

The possibility of having hurricanes and tornadoes in the region of the site was assessed and historical data of these phenomena were collected. For hurricanes, the associated risks were determined with the available data, considering factors such as wind speed, pressure and extreme rainfall. For tornadoes, the risks considered were based on the maximum rotation

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of wind, pressure differentials and the pressure rate of change. In both cases, the missiles supposedly generated by these phenomena were taken into account.

Floods

The possibility of occurrence of floods due to rains, tsunamis and seiches was assessed. For floods caused by rain, the meteorological and hydrological model was reviewed, taking into account the uncertainty and the amount of available data for the region. For floods caused by tsunamis, the likelihood of occurrence based on the seismic records and the known seismotectonic characteristics was addressed.

Geotectonics

The site and its surroundings were assessed to determine the potential for slope instability and ground liquefaction. The geologic maps to determine the existence of natural formations, such as caves, were also reviewed and the geotectonic characteristics of subsurface materials and the site soil profile were investigated.

Explosions

The region activities involving the handling, processing, transportation and storage of chemicals, or flammable materials that could cause explosions or clouds capable of producing gas deflagration or detonation were assessed. The risks associated with the explosions in terms of overpressure and toxicity was also assessed, taking into account the distance to the installation.

Regarding the mining project “Caballo Blanco" that was developed in 2011, CNSNS concluded that the controlled explosions carried out during the exploration phase did not impact adversely LVNPS structures. At the end of 2012, this project was cancelled by SEMARNAT. However, CNSNS will follow up, and if the project is resumed or a similar one is started, the corresponding evaluation would be performed to ensure that the design basis of LVNPS structures is maintained.

Airplane crashes

The potential airplane crashes in the vicinity of the site were assessed, based on the characteristics of air traffic.

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Article 17 (2) Impact of the installation on individuals, society and environment

- Criteria for evaluating the likely safety related impact of the nuclear installation on the surrounding population and the environment

In compliance with the General Law of Ecological Equilibrium and Environmental Protection, as well as the requirements for granting LVNPS's Licence for Commercial Operation, CFE submitted to CNSNS a Final Environmental Impact Report following the guidelines of the USNRC Regulatory Guide 4.2. The main purpose of this report is to demonstrate that the impact of LVNPS operation will not cause relevant disturbances in the site's immediate environment.

Currently, as part of its ongoing plans and the licence renewal application that LVNPS has been working on, CNSNS incorporated 10 CFR 51 as part of the regulatory framework and guidelines of Regulatory Guide 4.2 Supplement 1, in order to establish standards for evaluating the facility's impact over its lifetime. The corresponding information was submitted to CNSNS in March 2015 and is under review.

- Implementation of these criteria in the licencing process

LVNPS's licence holder has established an environmental surveillance program to determine the impact of normal LVNPS operation. The surveillance program is governed by Section 12 of the LVNPS Units 1 and 2 Technical Specifications. This program was run since 1978, depending on the type of sample, in the pre-operational phase up to 1988 to determine the baseline. This baseline enables comparing the data generated during normal LVNPS operation, allowing detecting quickly and safely any alteration to the environment. It is important to mention that LVNPS carries out an environmental surveillance program 300% larger than that established in the TS, ensuring a more effective and efficient surveillance of the environment and the population.

Prior to the granting of the Licence for Commercial Operation for LVNPS Units 1 and 2, CNSNS assessed the FEIR both, for normal operation conditions, in terms of the radioactive liquid and gaseous, chemicals, biocides and sanitary effluents; as well as for abnormal conditions or accident scenarios. The scenarios assumed for the assessment had the objective to verify the installation's capacity to control and mitigate the severe abnormal conditions, although the scenarios had a very low occurrence probability. CNSNS concluded that the real impact of LVNPS operation produces effects on the environment that fully meet the design bases of the installation. Despite the appropriateness and reliability of the environment surveillance program developed and implemented by CFE, and that its results are subjected to an international inter-comparison analysis; since 1979 CNSNS started a program for measuring environmental samples to determine the baseline and monitor LVNPS operation completely independent of CFE's program.

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Up to now, the results obtained by CFE have been consistent with those obtained by CNSNS. The pre-operational environmental radioactivity values and the current data show no statistically significant variations among them.

Article 17 (3) Re-evaluation of site related factors

- **Activities for re-evaluation of the site related factors as mentioned in Article 17 (1) of the Convention to ensure the continued acceptability of the safety of the nuclear installation conducted according to appropriate standards and practices**

The site-related factors that have required re-assessment to ensure a continuous safety level at LVNPS are:

1. Seismic events.

   LVNPS staff has recorded a number of seismic events. However, in no case has exceeded the design basis, even with CFE incorporating the concept of cumulative absolute velocity (CAV).

2. Identification of the design basis for the maximum wave height, the magnitude and direction of winds, and tide applicable to the design of LVNPS's intake structure.

   LVNPS staff, driven by the external operational experience, reviewed the available historical data of the wave height, and the magnitude and direction of winds and tide to determine if they are covered by the original design or implement if they were necessary changes based on the results.

3. Intake structure fouling due to the entry of sargassum (a type of seaweed).

   LVNPS staff, driven by the external operational experience, reviewed if there were intake structure fouling events caused by organic and inorganic material.

- **Results of recent re-evaluation activities**

The results from site-related activities that have required re-assessments were:

1. Seismic events.

   It was concluded that the seismic events re-assessed have not had adverse effects on LVNPS safety. However, conservatively the following measures were taken: (a) the guidelines of the USNRC Regulatory Guide 1.166 "Pre-Earthquake Planning and Immediate Nuclear Power Plant Operator Post-Earthquake Actions", which consider the

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effects of high frequency ground motions, were adopted. Therefore, the OBE Exceedance Criterion was incorporated into LVNPS; (b) the nuclear damage scale proposed in Electrical Power Research Institute (EPRI) NP-6695 "Guidelines for Nuclear Plant Response to an Earthquake" was incorporated, which is similar to the Mercalli Intensity Scale; (c) LVNPS seismic monitoring system was updated; and (d) after the Fukushima nuclear plant accident, the analysis "Re-assessment of the seismic risk for the Laguna Verde Nuclear Power Station site" was prepared in 2012. The analysis using current techniques and methods, confirms that LVNPS meets the design requirements set by the regulatory guidelines.

2. Identification of the design basis for the maximum wave height, the magnitude and direction of winds and tide applicable to the design of LVNPS's intake structure.

   It was determined that:

   a) For the period 1980 to 2009, a maximum wind speed of 163 km/h at the site occurred in 1986, which is below the Probable Maximum Hurricane of 304 km/h and the Standard Design Hurricane (SDH) of 234 km/h parameters for LVNPS. For the period 1871-2015 the maximum wind speed recorded in the vicinity of the site is 280 km/h due to the tropical cyclone "Janet" which occurred in 1955. Therefore, the wind magnitude and direction used as design basis remain valid.

   b) The average wave heights that have been recorded at LVNPS site are in the range of 0.1 to 0.5 m. Therefore, the actual maximum wave height has not exceeded the design parameter of 5.5 m.

   c) The sea levels recorded at LVNPS's intake structure associated with the natural low and high tides are within the design range of -1.6 m and 4.136 m. As a preventative measure, dredging of the water intake channel is an ongoing maintenance task.

3. Intake structure fouling due to the entry of sargassum.

   As a result of the assessment, it was found that the fixed and travelling mesh capacity, based on the design parameters, is greater than the water intake requirements. However, considering the maximum expected rate of arrival and the physical characteristics of sargassum, and the rake configuration, both the fixed and travelling mesh would be blocked by the sargassum trapped into them. To address this issue, a nylon mesh at the basin entrance preventing the massive transfer of sargassum into the intake was installed. The amount of sargassum that can go through the nylon mesh is within the removal capacity of the fixed and travelling mesh cleaning systems.

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- **Regulatory review and control activities**

The regulatory control and assessment activities performed include the following:

1. Seismic events.

   CNSNS has assessed the analysis performed by the licence holder to evaluate the effects of seismic events. CNSNS has determined that no damage has occurred to the LVNPS Structures, Systems and Components. The actions taken by LVNPS were also considered conservative and acceptable.

   As a result of the 2011 Fukushima Daiichi event, CNSNS agrees that the seismic design bases are validated by obtaining a peak ground acceleration (PGA) of 0.24g, which is less than the design value for a safe-shutdown earthquake (SSE) of 0.26g

2. Identification of the design bases for the maximum wave height, the magnitude and direction of winds and tide applicable to structures in LVNPS's intake structure.

   As a result of the assessment performed by CNSNS, it was found that the tide (sea water levels), the magnitude and direction of winds, and swell at the intake structure are within the original design parameters. In addition, the ongoing dredging of the water intake channel has kept the water level in the basin always above the established minimum.

   As a result of the 2011 Fukushima Daiichi event, CNSNS agrees that the controlling design event is a tsunami, while in the case of LVNPS the controlling event is a hurricane. From the point of view of design margins under flooding, in the Fukushima Daiichi event, the maximum water level reached, according to experts, 10 m, far exceeding the critical design level of 5.7 m. At LVNPS, the critical design level is 6.5 m, while the probable maximum level during a design-basis hurricane is only 3.66 m.

3. Intake structure fouling due to the entry of sargassum.

   As a result of the assessment performed by CNSNS, which included the possible loosening of the nylon mesh, it was found that it is not possible to have an accident different from those previously analysed in the FSAR nor it is an "unreviewed safety issue". Although the fixed and travelling mesh system is not safety related, the arrival of sargassum does not compromise LVNPS safety because of the adequate monitoring and filtering and cleaning devices installed, as well as their current status.

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Article 17 (4) Consultation with other Contracting Parties likely to be affected by the installation

- International arrangements

An international agreement subscribed by Mexico is understood as any *"written international agreement agreed between States and governed by international law, whether embodied in a single instrument or in two or more related instruments, and whatever its particular designation"* as stated in Article 2, Paragraph a) of the Vienna Convention on the Law of Treaties of 1969 and those celebrated between Mexico and international organisations.

The international treaties signed by Mexico on nuclear safety are presented in Annexe 7.1.

- Bilateral agreements with neighbouring States, as applicable and as necessary

A bilateral agreement signed by Mexico is understood as any agreement reached by two States that legally obliges only the two of them and it has benefits that generally are not shared with a third State.

The bilateral agreements signed by Mexico on nuclear safety are presented in Annexe 7.2.

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ARTICLE 18. DESIGN AND CONSTRUCTION

Obligations

"Each Contracting Party shall take the appropriate steps to ensure that:

i) The design and construction of a nuclear installation provides for several reliable levels and methods of protection (defence in depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences if they occur;

ii) The technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis;

iii) The design of a nuclear installation allows for reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface."

Article 18 (1) Implementation of defence in depth

– Overview of the Contracting Party's arrangements and regulatory requirements concerning the design and construction of nuclear installations

The Regulatory Law of the Constitutional Article 27 on Nuclear Matters in Articles 15, 19, 20, 21, 25, 26, 28, 32, 34 and 50, in general terms, establishes the requirements to be satisfied by nuclear installations from the design phase, during construction and the operation phase.

Since the first edition of the Nuclear Law that dates from 1979, when the design of Laguna Verde Nuclear Power Station (LVNPS) was found to be quite advanced and the construction already had initiated four years back, the criteria that ruled the general conception of the original design was based on the philosophy that *"any nuclear installation built in Mexico shall satisfy the applicable requirements as it should be licenced in the country of origin of the Nuclear Steam Supply System"*. Due to this, the first agreement of the referenced standard for licencing LVNPS was based on Title 10 "Energy" of the Code of Federal Regulations (CFR) of the United States of America or 10 CFR.

In particular, 10 CFR 50 and his Appendix A establish fundamental criteria for design, fabrication, construction, testing and performance requirements for Structures, Systems and Components (SSC) important to safety. This ensures in a reasonable manner that the installation may be operated without undue risk to health and safety of operational personnel and that of the public and their property.

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Based on this regulatory framework, basic design criteria satisfied the following six groups: General Requirements, Protection by Means of Multiple Barriers Against Fission Products, Protection and Reactivity Control Systems, Fluid Systems, Reactor Containment, and Fuel and Radioactivity Control.

On the other hand, the construction process was performed in compliance with industrial standards, codes, industrial and quality standards corresponding to the quality required by the nuclear industry in USA. For example, concrete structures were raised under the standards of the American Concrete Institute (ACI), mechanic systems and components under the standards of the American Society of Mechanical Engineers (ASME) Code Section III, Division I and United States Nuclear Regulatory Commission (USNRC) Regulatory Guides (RGs) 1.20, 1.46, 1.60, 1.61, 1.92 y 1.122, among others.

Electrical and electronic components were constructed, fabricated and qualified taking into account the standards requirements of the Institute of Electrical and Electronic Engineers (IEEE); the selection of special materials, welds, paintings, etc. were performed in accordance with standards of the American Society of Testing Material (ASTM).

Other aspects such as the Pre-service and In-service Inspections of the coolant pressure boundary components were carried out and currently are performed based on the ASME Code Section XI, and the assessment of the Quality Assurance Programmes (QAP) based on standards from the American National Standards Institute (ANSI), Series ANSI N45.2.

- **Status with regard to the application for all nuclear installations of the defence in depth concept, providing for multiple levels of protection of the fuel, the primary pressure boundary and the containment, with account taken of internal and external events and the impact of related sequential natural external events (e.g., tsunami caused by an earthquake, mud slide caused by heavy rain)**

The barrier integrity maintenance to prevent the leak of radioactive material was adopted from the siting selection, conceptual and specific design stage including the construction stage of LVNPS.

The focus covered the three following levels:

Level One

LVNPS has been demanding a high degree of reliability to prevent the occurrence of abnormal situations by incorporating in the design the redundancy and diversity necessary to guarantee that critical functions (reactivity control, core cooling and control of radioactive material) are permanently guaranteed, relying for this purpose on methodologies

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such as quality assurance and the capability of important systems to be tested and inspected.

Level Two

LVNPS postulated that despite the care adopted in Level one, occasional abnormal situations could arise; therefore, all necessary devices should be incorporated in the design to avoid such situations from becoming an accident.

Level One and Two were evaluated in Chapter XV of the Final Safety Analysis Report (FSAR) and in the Probabilistic Safety Analysis (PSA) Levels 1 and 2 (Individual Plant Examination).

Level Three

The presence of a very low probability event exceeding design basis is assumed, resulting in core damage and release of radioactive material to the environment. Developing and implementing the External Radiological Emergency Plan (EREP) based on the analysis performed is a practicable application of this level.

In addition, CFE is implementing diverse and flexible coping strategies (FLEX), based on NEI 12-06 Rev. 1, as well as NEI 12-02 Rev. 1 and NEI 13-02 Rev. 1 (see Article 6 and later in this article).

- **Extent of use of design principles, such as passive safety or the fail safe function, automation, physical and functional separation, redundancy and diversity, for different types and generations of nuclear installations**

The list presented below provides a better understanding to what extent the design principles are used at LVNPS.

1. The essential safety actions are carried out by equipment with sufficient redundancy and independence, in such a way that no single failure, of active or passive components, prevents the function required, even in some cases in the long term.
2. The passive components of safety systems and engineered safety features are operated from the control room.
3. The design of nuclear safety systems and engineered safety features assure their functionality demonstration.
4. The design of nuclear safety systems and engineered safety features includes factors that take into consideration natural phenomena such as: earthquakes, floods and storms that might occur at LVNPS site.

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5. The electrical power supplies on reserve have sufficient capacity to energize all the nuclear safety systems and engineered safety features.
6. The design incorporates electrical power supplies on reserve to enable a fast shutdown and reactor decay heat removal, when the normal auxiliary power is not available.
7. LVNPS has redundant capacity and operational independence for shutting down the reactor, independently of the normal reactivity control. This support system has the capacity to shut down the reactor from any normal condition and to keep it in that condition.
8. The systems that have a redundant or backup safety function are physically separated and arranged so that any credible event that could cause damage to a region of the nuclear island does not compromise the functional capacity of the counterpart system.
9. None of the equipment or systems required for a safe shutdown of the reactor is shared between Units 1 and 2.

As future activities, LVNPS is developing accident mitigation strategies for the reactor, the primary containment and the spent fuel pool (SFP), which will be implemented in the medium term to comply with the provisions of 10 CFR 50.54(hh)(2) following the Nuclear Energy Institute's NEI 06-12 Rev. 2 guidelines such as the following:

- Manual operation of RCIC.
- Supply of direct current to depressurise the Reactor Pressure Vessel (RPV) and injection with portable pump.
- Use of the condensate and feed water system.
- Makeup of the condenser hot well.
- Portable spray.
- Makeup of spent fuel pool inventory from internal and external sources.
- SFP spray from internal and external sources.
- Leak control strategies for SFP damage.
- Damage evaluation and fire management strategies.

- **Implementation of design measures or changes (plant modifications, backfitting) with the objective of preventing beyond design basis accidents and mitigating their radiological consequences if they were to occur (this applies to the entire nuclear installation including spent fuel pools)**

LVNPS has implemented design measures to prevent the occurrence of Design Basis Accidents (DBAs) or mitigate their radiological consequences. The Three Mile Island accident

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was assessed and the design and operational lessons learned were considered, in compliance with the NUREG 0737 requirements. The actions taken are described in Appendix A of the FSAR.

Post-Fukushima Daiichi (1F) Actions at Laguna Verde Nuclear Power Station

As of the closing date of this National Report, in addition to the requirements for the stress tests and 10 CFR 50.54(hh)(2), CFE is implementing diverse and flexible coping strategies (FLEX), based on NEI 12-06 Rev. 1, as well as NEI 12-02 Rev. 1 and NEI 13-02 Rev. 1.

As the name implies, FLEX provides flexible and diverse ways to prevent fuel failure (reactor and spent pool fuel) and maintain containment during a beyond-design-basis external event. With this, there is a substantial increase in the plant's defence in depth.

There are three phases of the mitigation strategy:

1. In the first phase, the event must be faced, making use of the equipment installed at LVNPS.
2. The second phase involves transitioning from using installed equipment to on-site portable equipment.
3. In the third phase, additional response capacity must be obtained and redundant portable equipment from off-site must be utilized until electric power, the inventory of water, and the coolant injection systems have been restored.

Attention to the "Technical Points to be Considered" instructions

In compliance with the "Technical Points to be Considered' in CNS/ExM/2012/12 Rev. 1 ("Chairman's Report of the Special Meeting, Second Special Meeting of the Contracting Parties to the Convention on Nuclear Safety", August 2012, Annexe III, Paragraph 23), also described in the minutes (point 2.b) of the "6th Board Officers Review Meeting" of the Convention on Nuclear Safety, held on October 29, 2012, the following is reported:

<u>Earthquakes and Floods; Follow-up actions taken or planned, including improvement measures</u>

> Based on CNSNS's stress test requirements, CFE requested the Engineering Institute of the Mexican National University (IIUNAM) to update the seismological and flood-related information and the associated calculations in order to confirm the seismic and flood (sea-land and land-sea) design-bases are still valid. For its part, the regulatory body evaluated these studies and is in agreement with CFE's conclusions. The results are detailed in Article 14.

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Follow-up actions taken or planned to withstand beyond-design-basis natural hazards

The combination of land-sea events (probable maximum precipitation / runoff) with sea-land events (waves / swell / wind / tidal surge) present a beyond-design-basis condition for LVNPS, however they are not a weak point or a limiting situation for its buildings or components. This is because of the raised elevation of the buildings, the flood levels determined for the postulated events, and finally, the fact that there is no direct connection between the basin and the two lagoons, Laguna Salada and Laguna Verde. Their only connection is via the sea.

In relation to the combination of events such as an earthquake that could induce failure of a water-retention structure (e.g., dam, retaining wall) or a body of water (reservoir or lagoon) and consequently a beyond-design-basis flood; at LVNPS there doesn't exist in the main basin or the neighbouring lagoons a structure or body of water with said characteristics, thus the postulated sequence of events is not applicable.

Improving the management of accidents from extreme natural phenomena

1) Core cooling

In relation with the currently available measures of management of accidents involving protecting the core in the distinct stages of a scenario of loss of cooling, LVNPS has established, in the Emergency Procedures and the Internal Emergency Plan, the actions that the operations and emergency response personnel must perform during an event in order to avoid damage to the core. Said procedures include actions that allow depressurization of the primary system, as well as planned measures to prevent core damage.

LVNPS emergency procedures are symptomatic and instruct that, at all times, water must be injected into the reactor vessel; in cases where that is not possible, instruction is given to flood the primary containment to a level that ensures that the core is completely covered.

Beyond-design-basis natural disasters are identified as potential causes of an extreme situation, for which actions are taken, including modifications that enable the use of portable equipment to supplement what is required of equipment installed at LVNPS but might be unavailable as a consequence of the event.

With relation to the adequacy and viability of the instrumentation, LVNPS is evaluating methods for reading critical parameters in case of a total loss of power.

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2) Primary containment

The primary containment of each of LVNPS's units is inertized such that, if hydrogen is generated as a consequence of core damage, the possibility of explosion is avoided. In addition, LVNPS's hydrogen recombination systems are placed in service according to the emergency operating procedures.

In order to prevent overpressurisation, LVNPS is designed with purge and vent systems that allow the primary containment's pressure to be released. It also has an emergency venting with the ability to evacuate a vapour flow without exceeding the containment's design pressure. If the pressure decrease is achieved successfully with the normal purge and vent systems, LVNPS's procedures have this done from the suppression chamber, providing the opportunity to scrub the gases by passing them through the suppression pool before they are released to the atmosphere. If emergency venting is used, the gases cannot be scrubbed, as it is vented from the drywell.

LVNPS is in the process of:

- Implementing of a hardened, drywell vent, as well as designing a hardened, wetwell vent; the discharge tubes of these vents come together inside the reactor building before passing outside.

- The evaluation of additional measures to ensure the availability of the energy required to run the equipment that maintains the integrity of the primary containment, in the case of a severe accident.

3) Spent fuel pool

The fuel pool cooling and cleaning system (FPCC) provides sufficient water to the spent fuel pool (SFP) to maintain its level and adequate radiation shielding.

The design of the spent fuel pool does not allow its level to be decreased by siphoning. The only decrease in its level, prior to a loss of the cooling system, is through evaporation.

LVNPS's procedures set the manual actions for the alternate water supply to the spent fuel pool, using demineralized water of the condensate supply system from the condensate storage tanks, raw fire-protection water, and seawater through the nuclear service water system.

LVNPS is implementing strategies for SFP inventory replacement and spraying, using a portable diesel pump and various spare water sources. Taking beyond-design-basis external events into consideration, they are also establishing the

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Laguna Verde lagoon as a spare water source for the spent fuel pools of both units; it has enough capacity to supply the pools for more than 72 hours.

A project to diversify the spent fuel pool's instrumentation is also in process. This instrumentation will be capable of reliably monitoring the SFP during extended power losses and during beyond-design-basis events.

4) Alternate water supply

LVNPS is in the process of implementing improvements to the facility to provide an alternate supply of water in addition to the sources considered in the original design (ultimate heat sink, condensate storage tanks, suppression pool, etc.).

To this end, and based on scenarios that don't rely on external and internal sources of alternating current for more than the beyond-design-basis time or for more than 72 hours, the strategy to be implemented considers the following:

- An arrangement with on-site portable equipment that will be deployed when required to ensure adequate core cooling, containment integrity, and cooling of the spent fuel pool. The portable equipment will rely on primary and alternate connection points to perform the cooling and supply replenishment functions.

  Portable equipment to be used for an alternate supply of water will be protected against unexpected effects in a facility relatively near LVNPS's process buildings.

- There are two options for the water supply for replenishing the inventory:

  Option A – Laguna Verde. Water injection to replenish inventory in the reactor vessel will be achieved using the Laguna Verde lagoon, located 1.5 km north of the units, providing the ability to extract a large quantity of water and send it a long distance.

  Option B – Tanks. Water supply from the insulator wash tanks, overflow tanks, and fire protection system tanks.

5) Availability of a source of power

LVNPS is connected to the eastern system of the national power grid by means of 7 transmission lines: 5 400 kV lines and 2 230 kV lines. LVNPS has the advantage of having an unusual number of transmission lines connected to the substation (in comparison with other plants of similar design), as well as having these lines

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coming from different directions. The means that there are at least three alternate, external sources of power for plant services in the case that one is lost.

Loss of off-site power (LOOP)

In the case of loss of off-site power, LVNPS has two emergency diesel generators, Divisions I and II, that will begin to restore alternating current power to the battery chargers. During start-up and charging of the emergency generators, the battery banks provide direct current.

The emergency diesel generators have the capacity to supply power for the essential divisions for the residual heat removal. The storage tanks contain sufficient fuel for the generators to run continuously for 176 hours. Additionally, the Division III generator begins to provide power to the high-pressure core spray system, and its fuel tank will allow it also to operate continuously for 176 hours.

The design characteristics allow LVNPS to sustain a loss of external power for more than 72 hours.

Loss of on-site and off-site power or station blackout (SBO)

As part of the licencing process, LVNPS analysed the scenario of total loss of internal and external alternating-current power, also known as a station blackout (SBO), in conformity with USNRC Regulatory Guide 1.155 Rev. 0 and NUMARC 8700. This methodology takes into account the characteristic climate of the site, the design of the power grid, the characteristics of the substation, the redundancy of the emergency alternating-current electrical system, and the reliability of the emergency diesel generators. The analysis determined that the facility must have the capacity to face a 4-hour SBO.

Actions to improve LVNPS's response to an extended SBO

As part of its regulatory commitments with CNSNS, CFE will implement the following mitigation strategies to strengthen the response to an extended SBO:

- Assess the feasibility of extending the required coping time, with on-site equipment, for an SBO from 4 to 8 hours. Then they will define the mitigation strategies to be used and when to make the transition to on-site portable equipment, with the goal of ensuring the ability to respond to the event until the necessary off-site supplies are available.
- Implement mitigation strategies in compliance with NEI 12-06 Rev. 1, as well as NEI 12-02 Rev. 1 and NEI 13-02 Rev 1. Among the strategies to be

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implemented so LVNPS can provide a more robust response to an extended SBO are:

i. Diversification of SFP level instrumentation and inventory replenishment alternatives.

ii. Portable power supply for reactor vessel depressurisation and water injection with a portable pump.

iii. Manual operation of the containment hardened vent system.

iv. The diesel generators currently installed at LVNPS will be electrically interconnected, in order to supply power to the direct-current battery chargers:

1. The central alarm station's generator will be connected to a new motor control centre that will be installed in Unit 1's Turbine Building Level 10.15. This connection will help power the 125 and 250 V DC battery chargers in order to face an extended loss of ac power (ELAP) of 72 hours, maintaining the key functions for reactor core cooling and primary containment integrity.

2. The integrated information processing system's generator will be connected to a new motor control centre that will be installed in Unit 2's Turbine Building Level 10.15. As with Unit 1, this connection will help power the 125 and 250 V DC battery chargers in order to face an extended loss of ac power (ELAP) of 72 hours, maintaining the key functions for reactor core cooling and primary containment integrity.

6) Measures to ensure containment integrity

The mitigation strategies to be implemented at LVNPS are intended to protect the integrity and function of the containment. The system will have the ability to locally or remotely vent containment before reaching a combination of pressure and temperature that puts its integrity at risk.

Among the strategies to be implemented is the construction of the hardened emergency vent line for containment and its release to the atmosphere, as well as the ability to manually open the line's isolation valves.

If necessary, it will have the ability to spray and/or flood the primary containment using on-site portable equipment, in order to mitigate radiological releases to the exterior.

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7) Containment: strategies for filtration and management of hydrogen

Both units' primary containment is inertized such that if hydrogen is generated as a result of core damage, the possibility of hydrogen explosion is avoided. Furthermore, LVNPS has hydrogen recombination systems, which are put into service in accordance with emergency procedures.
LVNPS's design has purge and vent systems that permit pressure release from the primary containment. This venting has the ability to evacuate the vapour flow without exceeding the primary containment's design pressure. LVNPS's procedures instruct that the pressure release should be made from the suppression chamber, as that provides the opportunity to scrub the gases before they are released to the outside by passing them through the suppression pool.

Additionally, as indicated previously, LVNPS has an emergency vent line from the dry well, with two isolation valves. This emergency vent is being renovated to add a vent line from the suppression chamber; both lines will be able to discharge to the atmosphere through a hardened pipe that extends to outside the secondary containment.

8) Probabilistic risk assessment to identify additional means to manage accidents

CFE is considering for LVNPS a set of viable, flexible, and generic strategies to be used to respond to extreme natural hazards. Some involve improvements in the procedures.

Other strategies that have been considered:

- RCIC system manual operation
- DC power source for reactor vessel depressurisation
- Maximize the coolant flow of the control rod drive (CRD) system
- Installation of the containment vent to the exterior and manual opening of the isolation valves of containment vent lines.
- Use of portable equipment to inject water into the reactor or spray the primary containment from external water sources

Once the strategies have been implemented, they will be reflected in PRA Levels 1 and 2, through an update, in order to identify if new vulnerabilities exist.

Finally, LVNPS is in the process of:

- Implementing the strategies required by 10 CFR 50.54(hh)(2).

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- Evaluating the additional strategies required to have the ability to respond to an extended SBO at the same time as loss of the ultimate heat sink (UHS).

LVNPS's post-1F (Fukushima) actions planned by CFE are divided into three parts, with the following completion dates:

- Compliance with 10 CFR 50.54(hh)(2), to be completed by December 2016.
- Stress tests, to be completed by December 2107.
- Compliance with Priority 1 recommendations, to be completed by December 2018.

Emergency preparedness and response improvements

This information is presented in Article 16.

Implementation of diverse and flexible coping strategies (FLEX)

As of the closing date of this National Report, in addition to the stress test requirements and those of 10 CFR 50.54(hh)(2), CFE in the process of implementing diverse and flexible coping strategies (FLEX) based on NEI 12-06 Rev. 1, NEI 12-02 Rev. 1 and NEI 13-02 Rev. 1.

FLEX provides diverse and flexible alternatives to prevent fuel failure (reactor core and/or SFP), maintaining containment integrity during a beyond-design-basis external event. This will increase the defence in depth.

The mitigation strategies include three phases:

1. Face the event with LVNPS's installed equipment.
2. Transition from LVNPS's installed equipment to on-site FLEX equipment.
3. Obtain and use additional and redundant off-site equipment until power, water inventory, and the coolant injection systems have been restored.

Severe Accident Management Guidelines

In response to CNSNS's requirements, CFE reported that for the Severe Accident Management Guidelines (SAMG) and the Extensive Damage Mitigation Guidelines (EDMG), it intends to implement the SAMG based on EPG/SAG Rev. 3's generic guidelines, developed by the Boiling Water Reactor Owners' Group (BWROG).

These guidelines were developed in response to NUREG-0737 Item I.C.1 "Guidance for the Evaluation and Development of Procedures for Transients and Accidents" and NEI 91-04

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"Severe Accident Issue Closure Guidelines," Rev. 1, respectively. Using these, the licence holders have developed their emergency and severe accident guidelines, adapting them for their specific technologies.

CFE reports that the emergency procedures, based on BWROG's already approved EPG/SAG Rev. 3 and support procedures, were implemented at LVNPS during the third week of October 2015 and established that they would be included in the July-August 2016 cycle of the Licenced Personnel Retraining Program.

Regulatory Body (CNSNS) Actions

During the period covered by this National Report, meetings were held every four months to confirm that CFE's actions were in compliance with CNSNS's requirements to be able to face an event of the magnitude encountered at Fukushima Daiichi.

CNSNS changed the scope of the inspection activities conducted by its staff, in order to verify CFE's actions during reactor operation or refuelling, determining the following:

- For actions required by 10 CFR 50.54(hh)(2), CNSNS verified the required constructive strategies, pending the location of some equipment, system tests, deployment, training, and approval/sending of final reports to the regulatory body.

- With regard to mitigation strategies for beyond-design-basis events, in conformance with CNSNS's requirements, the implementation of the hardened vent has been verified for: Phase 1, Stage 1 (wetwell) for both units; and Phase 1, Stage 2 for Unit 1.

Regarding the SAMG, CNSNS is in close communication with CFE, following BWROG's advances toward the release of their EDMG. With respect to the emergency operating procedures, based on BWROG's EPG/SAG Rev. 3 and support procedures, CNSNS approved their implementation during the July-August 2015 cycle of the Licenced Personnel Retraining Program.

Finally, CNSNS will generate, by the middle of 2016, a second report in which it summarises the actions taken by the regulatory body with respect to strategies undertaken by CFE to face an event of the magnitude encountered at Fukushima Daiichi.

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- **Implementation of particular measures to maintain, where appropriate, the integrity of the physical containment to avoid long term off-site contamination, in particular actions taken or planned to cope with natural hazards more severe than those considered in the design basis**

  As has been indicated in various sections of this National Report, CFE is in the process of implementing FLEX, based on NEI 12-06 Rev. 1, as well as NEI 12-02 Rev. 1 and NEI 13-02 Rev. 1.

  This subject is described in detail in "Post-Fukushima Daiichi (1F) Actions at Laguna Verde Nuclear Power Station" of the prior section, "Implementation of design measures or changes (plant modifications, backfitting) with the objective of preventing beyond design basis accidents and mitigating their radiological consequences if they were to occur (this applies to the entire nuclear installation including spent fuel pools).

- **Improvements implemented for design of nuclear power plants as a result of deterministic and probabilistic safety assessments made since the previous National Report; and an overview of main improvements implemented since the commissioning of the nuclear installations**

  The main LVNPS improvements since start-up were implemented during the 13th Refuelling Outage of Unit 1 (August 31 to December 9, 2008) and the 10th Refuelling Outage of Unit 2 (April 5 to May 31, 2009). The modification packages were implemented in preparation for the Extended Power Uprate (EPU) project up to 120% of the Rated Thermal Power (RTP). This is known as the 1st Phase of the EPU project.

  The 1st Phase of the EPU project included restoring and modernization of the Balance of Plant (BOP) systems of LVNPS Units 1 and 2. These modifications were considered necessary to ensure a correct and efficient operation, once the licencing process with the CNSNS and the Secretariat of Energy is complete. It was necessary to make several modifications and/or equipment and components replacement in the BOP systems to ensure proper operation once the units operate at the new EPU conditions. A summary of the LVNPS major improvements during 2008 and 2009 is presented below.

  ## Replacement of the Moisture Separator Reheaters with new equipment designed for the EPU conditions

  The assessment for the Extended Power Uprate operation conditions of up to 120% RTP concluded that it was necessary to replace, at least, the moisture separator and the piping of the two-stage reheating. However, considering the damage that they already had due to the erosion-corrosion effect experimented during the first years of operation, all the Moisture Separator Reheaters (MSRs) were replaced with others of new design.

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Installation of the new instrumentation of the MSR

The change of the Moisture Separator Reheaters (MSR A/B) with others of new advanced design with greater resistance to erosion–corrosion required replacing the following related instrumentation:

a) 10 level transmitters with advanced analogue technology.

b) Additional monitoring instrumentation for temperature and flow.

c) Impulse lines and digital flow transmitters in the MSR A/B area for normal system operation.

d) 2 instrument racks were installed in an area that meets the ALARA criterion, which will have local panel displays of the temperatures measured in the body of each MSR and Flow Indicators (FIs) for measuring the flow of the high and low pressure sides, and the drains of each MSR.

Replacement of the low and high pressure feedwater heaters

In preparation for the new EPU conditions, the existing low and high pressure feedwater heaters were replaced by heaters of greater capacity, which also have various thermal and mechanical improvements to enhance their performance.

Replacement of the main condenser piping

As a result of the LVNPS Extended Power Uprate project up to 120% of the RTP and the system operability, the main condenser was redesigned to:

1. Improve the BOP thermal cycle performance for the new EPU conditions.
2. Accommodate the air removal system due to the non-condensable flow increase, for the new EPU conditions.
3. Eliminate the copper carryover to the Feedwater System and the Reactor Pressure Vessel by replacing the Cu-Ni piping with Titanium piping.
4. Provide 40 years of service while minimising the potential for flow-induced vibration, maintenance and inspection intervals, and also excluding operational problems.

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Installation of an on-line cleaning system for the main condenser

A cleaning system for the condenser piping was installed in each one of 108" lines of the water circulation system, including backwash filters to have an efficient operation of the main condenser for the new 120% EPU conditions.

Replacement of the LVNPS Unit 1 primary containment H_2/O_2 analysers with similar ones to Unit 2

Before replacement, hydrogen concentration monitoring in LVNPS Unit 1's primary reactor containment was done using the Post-Accident Sampling System's (PASS) hydrogen analyser. This equipment was not redundant, so in case of failure there was no other way to monitor this parameter. Previously, oxygen concentration monitoring was done with the System T61's oxygen analyser, which was redundant.

According to LVNPS Unit 1 operational experience and maintenance records, the time required to calibrate the oxygen analysers had been excessive. Moreover, in some cases, it was necessary to ask the equipment supplier to check and calibrate the system. Additionally, there was an increasing difficulty to obtain spare parts due to its obsolescence.

Acoustic Side Branch installation in the safety relief valves standpipe of LVNPS Units 1 and 2 main steam lines

One of the main LVNPS improvements during this National Report period was implemented during the 14th Refuelling Outage of Unit 1 and the 11th Refuelling Outage of Unit 2. The improvement consisted of the Acoustic Side Branch (ASB) installation in the safety relief valves standpipe of LVNPS Units 1 and 2 main steam lines to comply with the required structural margins and qualification of the existing steam dryer for the Extended Power Uprate conditions.

Installation of a 4th condensate booster pump in LVNPS Units 1 and 2

A 4th condensate booster pump was installed as a result of the Extended Power Uprate project to have operation flexibility. The 4th pump prevents transients and loss of power generation and is designed with the same operation logic and setpoints of the existing pumps. The installation included the necessary instrumentation and control for the system operation and control.

Replacement of main generator and its associated instrumentation in LVNPS Units 1 and 2

The main generator and its associated instrumentation were replaced in LVNPS Units 1 and 2 as a result of the Extended Power Uprate project. The new generator has a larger electrical

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capacity and its design meets the EPU conditions. In this activity 18 current transformers of the protection system were replaced with transformers that have a higher transformation ratio. The generator grounding cubicle and all the associated wiring to this equipment were also replaced.

Modernization of HP, LP1 and LP2 turbines in LVNPS Units 1 and 2

The high pressure (HP) steam turbine and the two low pressure (LP1 and LP2) turbines were modified and refurbished as a result of the LVNPS Extended Power Uprate project to meet the conditions of this project. The new turbine was designed based on the Thermal Balance design for the existing turbines (HP, LP1 and LP2), but using the new generator capacity (817,106 kW) and the new components thermodynamic characteristics of the HP, LP1 and LP2 turbines to operate in optimum conditions.

- **Regulatory review and control activities**

The review of the generic letters issued by the USNRC is part of the regular follow-up of the changes to the regulations of the Nuclear Steam Supply System (NSSS) supplier's country of origin. In this reporting period, the generic letter GL 2006-02 "Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power" is of particular interest. The licence holder is carrying out the actions requested in this letter and the corresponding regulatory assessments were performed.

Article 18 (2) Incorporation of proven technologies

- **Contracting Party's arrangements and regulatory requirements for the use of technologies proven by experience or qualified by testing or analysis**

CFE as a policy, for major changes and equipment upgrades taking place in LVNPS, follows the criterion of not using technologies that are not tested or have not been used primarily in other nuclear power plants.

- **Measures taken by the licence holder to implement proven technologies**

All the modifications that use new proven technologies are evaluated according to the 10 CFR 50.59 and released to the regulatory body, CNSNS, for advanced approval. The objective of the evaluation is to assure that facility changes don't result in the plant operating in a condition that hasn't been analysed or authorised, determining if the activity, change, test, or experiment requires previous authorization from CNSNS. This is done with the intention to maintain the original basis for licencing contained in CNSNS's summary information component of the operations licence application and its subsequent amendments.

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- **Analysis, testing and experimental methods to qualify new technologies, such as digital instrumentation and control of equipment**

  All the digital instrumentation that uses software and control panels of equipment are tested and validated before and after their installation. This software is governed by a Quality Assurance plan based on the requirements of 10 CFR 50, Appendix B. The software's QA programme is monitored by CNSNS and controlled by CFE using its own procedures.

- **Regulatory review and control activities**

  CNSNS verifies that the new technologies are tested in accordance with the provisions of 10 CFR 52.47(b) either through the analysis of information provided by the supplier, a suitable testing programme, operational experience, or a combination of all of the above.

Article 18 (3) Design for reliable, stable and manageable operation

- **Overview of the Contracting Party's arrangements and regulatory requirements for reliable, stable and easily manageable operation, with specific consideration of human factors and human-machine interface**
-

  LVNPS considers the human factors and human-machine interface in the design of nuclear installations. Specifically, the FSAR documents the review of the human factors engineering in the design of the Main Control Room and control centres that are located outside the MCR. Article 12 OF THIS National Report also discusses the human factors issue in more detail.

  LVNPS conducts activities related to human factors engineering and human-machine interface according to Chapter 18 of NUREG-0800 "Standard Review Plan" Rev.1, and NUREG-0700 "Human-System Interface Design Review Guideline" Rev. 2 issued in May 2002. In addition, LVNPS also uses NUREG-0711 "Human Factors Engineering Program Review Model," Rev. 2 to evaluate the design of the control rooms.

- **Implementation measures taken by the licence holder**

  The measures taken by the LVNPS licence holder to consider human factors resulting from the Three Mile Island accident are described in Article 12 of this National Report.

- **Regulatory review and control activities**

  Recently, LVNPS has continued replacing analogue instrumentation with digital instrumentation. The digital technology is able to improve the operational performance and the adoption of these technologies in the nuclear industry represents a challenge for regulatory bodies. In particular, these challenges include (1) digital technology is more

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complex than analogue technology; (2) digital technology is rapidly changing and requires the CNSNS's staff updating their knowledge about the design, testing and applications; (3) new failure modes associated with digital instrumentation; and (4) the need to update the acceptance criteria and review the procedures used to evaluate the digital systems safety.

As part of the control activities for safe, stable and easily manageable operation with special consideration on human factors and human-machine interface; the CNSNS has been following-up these issues through its Baseline Inspection Programme in the Operation, Training, Maintenance, Instrumentation and Control, and Engineering areas, as well as during the LVNPS Reactor Operators (ROs) and Senior Reactor Operators (SROs) licencing process.

During the period covered by the present National Report, CNSNS began reviewing human and organisational factors through an inspection based on NUREG-0711, "Human Factors Engineering Program Review Model," which is described in detail in Article 12. The review of the safety culture is still in draft form because of limited available staff specialists. Therefore, review continues with the expectation of defining and starting activities related to safety culture.

Currently, an early phase continues for defining the procedures to be followed by the CNSNS to carry out the inspections of its baseline programme to verify the safety assessment and improvement programmes regarding Organisation and Human Factors, as part of the Reactor Oversight Process.

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ARTICLE 19. OPERATION

Obligations

"Each Contracting Party shall take the appropriate steps to ensure that:

i) the initial authorisation to operate a nuclear installation is based upon an appropriate safety analysis and a commissioning programme demonstrating that the installation, as constructed, is consistent with design and safety requirements;

ii) operational limits and conditions derived from the safety analysis, tests and operational experience are defined and revised as necessary for identifying safe boundaries for operation;

iii) operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with approved procedures;

iv) procedures are established for responding to anticipated operational occurrences and to accidents;

v) necessary engineering and technical support in all safety-related fields is available throughout the lifetime of a nuclear installation;

vi) incidents significant to safety are reported in a timely manner by the licence holder to the Regulatory Body;

vii) programmes to collect and analyse operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used to share important experience with international bodies and with other operating organisations and regulatory bodies;

viii) the generation of radioactive waste resulting from the operation of a nuclear installation is kept to the minimum practicable for the process concerned, both in activity and in volume, and any necessary treatment and storage of spent fuel and waste directly related to the operation and on the same site as that of the nuclear installation take into consideration conditioning and disposal."

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Article 19 (1) Initial authorisation

- **Overview of the Contracting Party's arrangements and regulatory requirements for the commissioning of a nuclear installation, demonstrating that the installation, as constructed, is consistent with design requirements and safety requirements**

As mentioned in other articles of this National Report, CNSNS is a semi-autonomous organism body under the Secretariat of Energy responsible for verifying the compliance of the national and international regulations for the siting, design, construction, commissioning and operation of nuclear installations.

CNSNS, to fulfil its functions, has established a two-stage "Licencing Process": the first one starts with the formal delivery by the licence holder of the Construction Permit Application accompanied by an installation characteristics description with particular emphasis on the safety systems that the installation will have to ensure that it will not present an undue risk to public and environment. Among the documents sent by CFE to CNSNS to support the Laguna Verde Nuclear Power Station (LVNPS) application are the following:

a) Preliminary Safety Analysis Report (PSAR)

b) Preliminary Environmental Impact Assessment (PEIA) Report.

During this stage, CNSNS reviewed the design criteria (Structures, Systems and Components [SSC] characteristics, nuclear analysis, etc.) and particularly all the issues related to the impact of the site characteristics on the SSC design of the installation, and the impact of the installation on the environment. After reviewing these reports, a technical report was sent to the Secretariat of Energy to support and issue the Construction Permit.

During the LVNPS construction, CNSNS through audits and inspections, supervised this phase to assure that the installation was built in accordance with the safety analysis report and the conditions set by the Construction Permit.

Once the detailed design of the installation was finalized, the Licence for Commercial Operation was requested for the licensee, as part of CNSNS's licencing process second stage. The following information supported the application:

a) The Final Safety Analysis Report (FSAR)

b) Final Environmental Impact Report (FEIR)

CNSNS assessed these reports, including the acceptance criteria for pre-operational testing, and start-up testing; also the proposed Technical Specifications were assessed. These

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assessments and the results from CNSNS's inspections and audits allowed preparing a technical report for the Secretariat of Energy to issue the LVNPS Licence for Commercial Operation.

- **Conduct of appropriate safety analyses**

In the initial licencing, the Preliminary and the Final Safety Analysis Reports were defined within the regulatory framework and in accordance with the format set in the USNRC Regulatory Guide 1.70.

For granting the LVNPS original Licence for Commercial Operation, CNSNS reviewed the Final Safety Analysis Report, taking advantage of the experience gained in reviewing the Preliminary Safety Analysis Report, supported by experts from the International Atomic Energy Agency in some particular topics, through the Technical Cooperation Programmes.

Later, in the LVNPS commercial operation phase, CNSNS reviewed and assessed the safety analysis report for the power uprate up to 5% of the Rated Thermal Power (RTP) which covered almost every topic of the original Final Safety Analysis Report. CNSNS's assessments were documented in a Safety Evaluation Report. CNSNS witnessed each of the five output levels, from 101% to 105%, so it was found stable behaviour of the plant. The safety analysis, for total steam and the new thermal power conditions were performed as part of the primary containment systems safety analysis in the event of a Loss of Coolant Accident (LOCA), both inside and outside the containment.

In 2008, during LVNPS's operational stage, CNSNS started the review of the safety analysis for an extended power uprate of 20% of RTP. For this uprate, CFE made modifications to the plant (see Article 18), the most relevant being made to the nuclear steam supply system and the steam dryer, housed in the reactor of both units. Regulatory review of this document observed that a number of important questions were answered by CFE. As of the closing date of this National Report, CFE is working on a final issue, related to the temperature of the ultimate heat sink.

Another issue that has been included in the safety analysis is the March 11, 2011 accident at the Fukushima Daiichi plant in Japan. For this, CFE has conducted the stress tests required by CNSNS. This analysis is described in Article 14.

- **Commissioning programme**

As part of the compliance obligation with USNRC Regulatory Guide 1.68, a start-up programme was implemented in LVNPS. This programme began with the initial fuel loading for which the Technical Specifications were applied. The start-up programme was divided into four main phases:

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Phase I. Tests with Reactor Pressure Vessel (RPV) open (initial fuel loading)

Phase II. Initial heating

Phase III. Power tests

Phase IV. Warranty tests

Testing conditions

Within the previous mentioned testing phases, the start-up programme was divided into 8 test conditions, in which specific Structures, Systems and Components tests were performed.

Test condition	Conditions / Region of Flow-Power map
VA	From fuel loading up to the time of installation of the drywell cover.
CA	After installing the drywell cover and up until the reactor was settled at pressure and temperature rated conditions.
C1	Before and after synchronisation of main generator of 5% to 20% of the Rated Thermal Power, with reactor recirculation pumps at low speed and the control valve between the maximum and minimum position.
C2	After main generator synchronisation, with a control rod pattern of 50% to 75% at or below the recirculation flow master control lower analytical limit, up to a 50% RTP.
C3	From 50% to 75% of the control rod pattern, above 80% of the core flow and within the maximum allowable valve control opening up to a 75% RTP.
C4	At the natural circulating line and its intersection with the lines between 95% and 100% of rod patterns up to a 75% RTP.
C5	From the lines of 95% to 100% of the control rod patterns and between those of a minimum flow at the recirculation pumps (control valve in minimum position) rated speed and 5% above the inferior analytical limit of the recirculation flow automatic control up to a 75% RTP.
C6	Within 95% to 100% of RTP and between 95% and the maximum allowable flow through the core.

General acceptance criteria

Three general acceptance criteria were established to validate the start-up testing:

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a) Level 1 Acceptance criteria

Failure to meet the criteria of this level obliges the unit to be lead to a standby condition considered satisfactory and safe based on test results previously performed.

b) Level 2 Acceptance criteria

Failure to meet the criteria of this level does not require altering the test programme or operation of the unit. It is recommendable to investigate adjustments required as well as analytical and surveillance methods.

c) Level 3 Acceptance criteria

Failure to meet the criteria of this level does not require altering the test programme or unit operation. Limits established under this category are related to individual component expectations or transient behaviour of control loops. This level is not associated with RPV or fuel protection systems.

Start-up testing performed

The number of start-up tests performed for each one of the tests conditions to verify Balance of Plant systems (VS) and System Test (ST) for the systems of the Nuclear Steam Supply System (NSSS) is shown below.

Test Condition	(ST) Test Performed	(VS) Test Performed
Open RPV (VA)	15	3
Heating (CA)	28	11
Condition 1 (C1)	15	18
Condition 2 (C2)	21	36
Condition 3 (C3)	35	22
Condition 4 (C4)	6	0
Condition 5 (C5)	7	0
Condition 6 (C6)	47	40
Warranty	**2**	0
T O T A L:	**176**	**130**

Testing for the 5% power uprate

Due to the fact that under the 5% power uprate condition, neither the pressure at the Reactor Pressure Vessel nor the reactor recirculation flow were affected, many of the start-

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up tests were validated by analysis of the test results during the initial start-up testing for both LVNPS units. However, the change in the main steam flow required the following tests to prove the stable operation under this new condition:

a) Stable behaviour for normal operation.

b) Stable operation of the Reactor Core Isolation Cooling (RCIC) System.

c) Thermal limits evaluation and calibration of feedwater flow transmitters for each power step from 100% up to 105%.

d) Pressure Regulator Electro Hydraulic Control (EHC) (including regulator failure to verify the transference to the backup regulator)

e) Feedwater control and feedwater system, stable RPV level control and operation.

f) Chemistry.

g) Isotopic analysis.

h) Environmental radiological monitoring at the release and discharge points, inside the Restricted Area.

Testing for the 20% Extended Power Uprate

Once the changes resulting from the Extended Power Uprate (EPU) project were concluded, the testing execution for the power uprate started on May 2011. CNSNS authorised a 30-day testing period.

During this testing period, the manoeuvres for the power uprate in LVNPS Unit 1 were witnessed, which were executed in six steps authorised according to applicable procedures and Reactor Engineering instructions. The following power steps values (percentages based on 2,317 MWt of Rated Thermal Power) were used:

a) First power step at 89.6% RTP

b) Second power step at 91.9% RTP

c) Third power step at 94% RTP

d) Fourth power step at 96.2% RTP

e) Fifth power step at 98.4% RTP

f) Sixth power step at 100% RTP

For each one of the power steps the following tests were performed.

Power Step	Test Performed

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Power Step	Test Performed
a) First power step at 89.6% RTP	a) Power stabilisation test. b) Core performance and steam carryover determination test. c) Plant systems monitoring tests.
b) Second power step at 91.9% RTP	a) Functional test of the Feedwater Control System (FWCS) at EPU conditions (2,317 MWt) b) Functional test of the Digital Electro Hydraulic Control (DEHC) c) Functional test for area radiation mapping. d) Core performance and steam carryover determination test. e) Plant systems monitoring tests.
c) Third power step at 94% RTP	a) Functional test for area radiation mapping. b) Core performance and steam carryover determination test. c) Plant systems monitoring tests.
d) Fourth power step at 96.2% RTP	a) Functional test of the FWCS at EPU conditions (2,317 MWt) b) Functional test of the DEHC. c) Core performance and steam carryover determination test. d) Plant systems monitoring tests. e) Chemical and radiochemical parameters monitoring tests.
e) Fifth power step at 98.4% RTP	a) Core performance and steam carryover determination test.
f) Sixth power step at 100% RTP	a) Core performance and steam carryover determination test. b) Chemical and radiochemical parameters monitoring tests. c) Acquisition data test for the regulation increment. d) Functional test for area radiation mapping.

The same testing activity for the LVNPS Unit 2 additional 15% power uprate was verified and witnessed by CNSNS staff, using the same power steps of LVNPS Unit 1. Finally, it was found that CFE met the acceptance criteria for all the tests established in the respective procedures for both LVNPS units.

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- **Programmes of verification that installations, as constructed, are consistent with the design and in compliance with safety requirements**

Introduction

Once the nuclear safety levels are established by the design of the installation, acceptance criteria are established to ensure that the applicable standards and codes, design criteria, and quality requirements are satisfied by the Structures, Systems and Components (SSC) throughout the construction, erection, and testing phases. Similarly, it is required that the adequacy and quality of SSC important to safety are kept and optimized through operation phase. This in order to ensure that facility operation does not represent an undue risk to public health and safety.

Construction stage

At this stage, the main mean for achieving the safety levels required was strict compliance with LVNPS' Construction Quality Assurance Programme (CQAP).

Compliance with CQAP requirements was applied both to the behaviour of individuals and organisations.

The application of the CQAP is a mean for guaranteeing, in a highly reliable manner, that SSC important to safety shall be built, installed, inspected and tested in conformance with applicable design specifications, codes and regulations.

Operation stage

The following means have been implemented for the operation stage to maintain the installation at the highest safety levels required by CNSNS.

Technical Specifications

The document that regulates the operation of nuclear installations within the limits deriving from the safety analysis is denominated Technical Specifications. They are ruled by the 10 CFR 50.36.

LVNPS was designed under criteria directed to avoid radioactive material releases to the environment. In order to demonstrate the adequacy of its implementation, accidents hypothetically postulated were analysed and results were presented as part of the information in the Final Safety Analysis Report. This served to establish safety parameters or limits and conditions that restrict the operation of the installation beyond the same.

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The TS were developed based on USNRC NUREG-0123, parameters identified in the FSAR and recommendations in standard ANSI/ANS 5.8.4 in which it is specified that:

a) Each nuclear plant licence application shall include in the request "Technical Specifications" proposed, their bases and the administrative controls.

b) Each licence shall include Technical Specifications deriving from safety analysis and their evaluation by CNSNS.

The TS are incorporated in the Licence for Commercial Operation and they contain guidelines and conditions under LVNPS plant must operate. Compliance with the TS ensures that the operation is maintained within the limits determined by the safety analysis. Any deviation requires corrective actions to be taken and immediate notification to CNSNS. Any modification to the TS requires previous authorisation from CNSNS, since they are part of the Licence for Commercial Operation.

The TS are integrated by the following sections: (1) Definitions; (2) Safety limits and limiting setpoints of safety systems; (3) Operating limiting conditions; (4) Surveillance requirements; (5) Design characteristics; and (6) Administrative controls.

Maintaining the Safety Reports

In order to assure that LVNPS Units 1 and 2 shall operate during their lifetime in conformance with the bases that served for awarding the Licence for Commercial Operation, any change or modification to the installation, the procedures or the execution of tests or experiments ought to be submitted for a Safety Evaluation. The purpose for such evaluation is:

a) To review that all change proposed be covered by licence bases; that is, by analyses, models, methods and assumptions made in Safety Reports. This way, it is ensured that these bases are not modified and therefore do not require previous approval of CNSNS.

b) For those cases in which it is identified that the change proposed is not covered by the licence bases, to ensure that approval of CNSNS is required prior to the implementation of the change.

c) To identify whether the change proposed modifies or affects a Technical Specification, in which case previous authorisation shall be requested to CNSNS. If the authorisation is granted, the modification of such TS will be done by CNSNS.

d) To request a periodic summary report briefing each and every change performed, that due to their nature were not submitted for approval of CNSNS prior to their implementation, so that the regulatory body is informed of the nature of all changes.

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This process maintains the effectiveness of the safety analysis reports, implying that the operation of LVNPS Units 1 and 2 is always covered by the licence bases.

Periodic safety review

The Periodic Safety Review (PSR) provides a global view of plant safety, with the objective of determining the modifications that should be carried out in order to maintain a high level of safety. The specific goals of the PSR are the following:

a) Analyse the installation behaviour for different aspects of nuclear safety in a time period long enough to identify trends.

b) Verify the adequacy of the methodology used in conducting the analysis of various aspects of the nuclear safety of the installation documented in the periodic reports.

A more detailed description of the PSR is presented in Article 14 (1).

– Regulatory review and control activities

Revision of the FSAR, Section 14 “Testing Programmes” was performed to determine the capability of the initial test programme for LVNPS Units 1 and 2 as well as the evaluation of the execution of such tests and verification of the acceptance of the final results from a safety point of view. All this, as a prerequisite for the initial authorisation of operation of both LVNPS units.

In order to establish a very strict control over the performance of tests and over the power uprate programme and so to have no doubt about the reliability of the course and the decisions made on the route to 100% of power, CNSNS established a requirement through which different power steps would be subjected to an evaluation of LVNPS behaviour as regards to the testing performed at the preceding step. From here, it was established that LVNPS had to achieve authorisation from CNSNS to carry on. This process, during the testing to be performed, ensured that LVNPS would maintain itself within the standards established by the acceptance criteria. If for some reason, these tests did not satisfy the acceptance criteria, the corresponding analyses were demanded immediately.

During the start-up testing phase, CNSNS carried out 39 inspections to LVNPS Unit 1 and 17 inspections to LVNPS Unit 2. These inspections were intended to verify groups and activities related to the start-up testing, such as Instrumentation & Control, Reactor Engineering, Maintenance, Start-up Superintendence, Quality Assurance and Quality Control. Based on the above, the original Operation Licences were awarded on August 24, 1990 for LVNPS Unit 1 and April 10, 1995 for LVNPS Unit 2.

For the 5% Power Uprate condition, CNSNS evaluated and authorised the testing programme for both LVNPS units. The safety related tests were witnessed by CNSNS’s staff

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in order to verify that the expected values for safety and operational parameters were obtained as described in the Safety Analysis. As a consequence of the evaluation and analysis of the results, CNSNS determined LVNPS had a stable behaviour and that it could operate in the 5% Power Uprate condition. Finally, the Secretariat of Energy granted the new Licence for Commercial Operation in December 8, 1999 for both LVNPS units with the same expiration date as the original ones, that is, July 24, 2020 (Unit 1) and April 10, 2025 (Unit 2).

For the 20% Extended Power Uprate condition, CNSNS evaluated and authorised the testing programme for both LVNPS units. The safety related tests were witnessed by CNSNS's staff in order to verify that the expected values for safety and operational parameters were obtained as described in the Safety Analysis. However, as mentioned in Article 14 (1), CNSNS has not concluded its final assessment because at the end of this report period CFE is reviewing the problems associated with the high temperatures in the ultimate heat sink.

Article 19 (2) Operational limits and conditions

- **Overview of the Contracting Party's arrangements and regulatory requirements for the definition of safe boundaries of operation and the setting of operational limits and conditions**

The LVNPS Units 1 and 2 Licence for Commercial Operation contains the Technical Specifications which are the set of limits and conditions derived from the safety analysis, testing and operational experience. The 10 CFR 50.36 defines the requirements for the TS of a plant. The Technical Specifications should describe, at least, the specific characteristics of the installation and the operating condition required to protect the public health and safety. The applicant should identify the items that apply directly to maintain the integrity of physical barriers that are designed to contain radioactive material. Specifically, 10 CFR 50.36 requires that the TS should be derived from the analysis and assessments that are in the Final Safety Analysis Report. The LVNPS licence holder cannot, for any reason, change the TS without prior permission of CNSNS.

- **Implementation of operational limits and conditions, their documentation, training in them, and their availability to plant personnel engaged in safety related work**

The control of the limits and operating conditions are defined in the Technical Specifications, which determine the documentation required for the proper control of the situations that reduce the safety margin, whether planned or unexpected. The staff in charge of this control is generally the Licenced Senior Reactor Operators (SROs), who have been trained on the installation operation, with emphasis on the control of the Technical Specifications.

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The staff in charge of monitoring safety-related equipment is trained following the Systematic Approach to Training (SAT) methodology. This training is provided to the personnel of the operation, maintenance (mechanical, electrical or Instrumentation & Control), chemistry, engineering, and radiation protection areas.

The controlled copy of the Technical Specifications is under the custody of the LVNPS staff designated by CNSNS; in particular, at least two copies are located in the Main Control Room (MCR) of each unit.

Additionally, an updated electronic version of the TS is available in the LVNPS intranet, which can be accessed from any computer station located within the installation premises. There are also updated copies at CFE's offices located in the location named "Dos Bocas" (in State of Veracruz) and CNSNS's main office located in Mexico City.

- **Review and revision of operational limits and conditions as necessary**

The review of and changes to the Technical Specifications are usually performed when the facility's equipment, operating conditions, or administrative controls are changed.

Changes to the Technical Specifications must be supported with a safety analysis, which should include the potential impact they may have on the integrity of the fission products barriers, and sent as a change request to CNSNS for evaluation, and if applicable, approval is granted.

- **Regulatory review and control activities**

Assessment activities

Any request for change to the Technical Specifications enters the assessment process of CNSNS. This process is composed of a preliminary review of the documentation to verify that is complete and a detailed assessment of the specific aspects applicable to the licence holder. Throughout the process, the compliance with the licensing bases of the plant is verified. The end result of the assessment process is an assessment report and the corresponding conclusion.

Control activities

Any non-compliance to the TS shall be notified by the licence holder to CNSNS. In addition, the resident inspector verifies the operation log daily to assure the non-compliances were reported in accordance with the provisions of the existing regulation.

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Article 19 (3) Procedures for operation, maintenance, inspection and testing

- **Overview of the Contracting Party's arrangements and regulatory requirements on procedures for operation, maintenance, inspection and testing of a nuclear installation**

  As described in Article 13, all activities important to safety relating to the LVNPS Units 1 and 2 operation are performed with strict adherence to the Operation Quality Assurance Programme (OQAP). This obliges the use of approved procedures by qualified personnel.

- **Establishment of operating procedures, their implementation, periodic review, modification, approval and documentation**

Establishment of operating procedures

For control of all activities ruled by the Quality Assurance Programme, LVNPS has divided its procedures into the following groups.

a) Administrative Procedures

b) Operating procedures subdivided into: General Operation, Systems Operation, Abnormal Operation, Alarm Response, Emergency Operation, and Operational Verification

c) Maintenance procedures are classified into Preventive, Corrective, Refuelling, Special Processes, and Generic Maintenance

d) Reactor Engineering: Reactor Verification, Reactor Analysis, and Fuel Handling

e) Radiation Protection: Radiation Protection (Generic) and Reduction in Personnel Exposure (ALARA)

f) Internal Emergency Plan (IEP)

g) Instrumentation: Instrumentation Maintenance and Instrumentation Verification

h) Chemistry and Radiochemistry

i) Materials Control

j) Physical Security

k) Training

l) Quality Control: Generic Quality Control Activities, Non-destructive Examination, and Functional Testing

m) Control of Documents

n) Fire Protection

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o) Programming and Results

Application

LVNPS has a policy for applying the procedures, which establishes that all the installation personnel shall use and adhere to the procedures relating to their work activity.

Periodic assessment

LVNPS Procedure PAG-02 establishes the requirements for the preparation, issuance, review, approval, cancellation, and reactivation of the LVNPS operation procedures. The periodic assessments may be annual, every two years, every five years, or depending on the needs (for example, operational changes).

The procedure modifications can be due to operational changes or from the periodic review results.

The operational changes are those modifications to the procedures that do not change their purpose but are necessary to continue their application on the field; otherwise the plant safety or reliability would be affected. The scope of operational changes includes the modifications generated by the Corrective Action Programme (CAP) or modification packages.

- **Availability of the procedures to the relevant nuclear installation staff**

There are booths for the control and availability of procedures of all areas, such as maintenance, operation, etc. The location of the procedures that all staff can use is clearly indicated in these booths.

Additionally, an updated version of all the procedures is available in the LVNPS intranet, which can be accessed from any computer located within the installation premises. There are also updated copies at CFE's offices located in "Dos Bocas" (in State of Veracruz) and CNSNS's main office located in Mexico City.

- **Involvement of relevant nuclear installation staff in the development of procedures**

LVNPS has a policy for developing the procedures, which establishes that all the qualified personnel must be involved in the preparation, revision and approval of the procedures.

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- **Incorporation of operating procedures into the management system of the nuclear installation**

The management system of procedures is indicated in LVNPS Procedure PAG-02 for the management of the technical-operational procedures and in Procedure PAG-01 for the management of administrative procedures.

- **Regulatory review and control activities**

During preparation and conduction of the inspections contained in CNSNS's Baseline Inspection Programme, the inspection staff follows the guidelines established in USNRC Procedure IP-42453 "Operating Procedures Inspection". The regulatory control and assessment activities include the following:

a) Verify that the plant procedures are reviewed and approved in accordance with the Technical Specifications and Operation Licence conditions.

b) Verify that the technical adaptation of the procedures is consistent with the desired actions and operation modes.

c) Verify that interim changes to procedures are performed in accordance with the requirements of the Technical Specifications and administrative procedures.

Article 19 (4) Procedures for responding to operational occurrences and accidents

- **Overview of the Contracting Party's arrangements and regulatory requirements on procedures for responding to anticipated operational occurrences and accidents**

As a result of the accident at Three Mile Island Nuclear Power Plant in the United States of America, CNSNS requested CFE to review existing procedures for addressing transients and accidents. This motivated the application of the Emergency Procedure Guidelines (EPG) to LVNPS Units 1 and 2, which were developed in a generic manner for Boiling Water Reactors by the BWR Owner's Group (BWROG) of which CFE forms part.

The incorporation of the revised Emergency Operating Procedures (EOP) does not require amending the design basis of the plant and they are not part of the design basis considerations, but rather guidelines to respond to conditions beyond the licence basis.

CFE developed EOP for LVNPS using the Plant Specific Technical Guidelines (PSTG), which is based on the EPG in NEDO 31331 "BWR Owner's Group Emergency Procedures Guidelines"

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to comply with the intention of Item I.C.1 of NUREG-0737 "Guidelines for the assessment and development of transient and accident procedures"; therefore, the PSTG are based on the following:

a) The entry conditions and operator actions are linked to certain parameters and symptoms of the plant. The actions are appropriately specified to restore and maintain these key plant parameters within the limits that define a safe plant condition.

b) It is not required to identify an initiating event to determine which procedure developed with the PSTG should be used. Similarly, the operator actions prescribed are appropriate regardless of the initiating event or the sequence in which subsequent events may occur.

c) The operator actions prescribed are consistent with the manner in which control room operators actually operate, including the performance of concurrent or parallel actions.

d) The operator actions prescribed are based on the existing configuration of the Structures and Systems of the plant, with the exception of instrument ranges, regardless of changes that may be proposed or adopted in the future.

e) All possible plant conditions that can have general operation guidelines are covered, regardless of their occurrence probability. This is why the PSTG cover a wide range of conditions that include both the most and least severe conditions in comparison to those which were considered to develop the design basis of the plant. These conditions include multiple equipment failures and human errors.

f) Although there are guidelines to respond to plant conditions that may extend beyond the original design basis of the plant, there is no intention or purpose to extend any design basis above what is currently established.

g) The plant systems that can be used to respond effectively to plant emergency conditions are identified, regardless of their safety class or the qualification of the system equipment and components.

h) The operator actions, the limits and action levels are based on engineering calculations using best estimate methods, contrasting with the traditional analytical methods and assumptions of licensing and design basis.

i) The best possible operation guidelines are specified, regardless of the licensing assumptions or requirements, and the design basis. For example, the operator actions are not necessarily conditioned on a waiting time (say, 10 minutes) assumed as input to a licensing analysis.

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- **Establishment of event based and/or symptom based emergency operating procedures**

Introduction

The procedures that are used at LVNPS to respond with anticipation to operational incidents and accidents are divided into: 1) Abnormal Operating Procedures, which are based on events; and 2) Emergency Operating Procedures which are based on the PSTG indicated in the preceding overview item.

Abnormal Operating Procedures

An evaluation was performed on the design of LVNPS Units 1 and 2 to verify its response to foreseen operational incidents and accidents considered as design basis. These are classified in five categories as show below:

Category	Type of event	Occurrence Event/Year
I	Normal Operation	Normal
II	Anticipated Transients	1 – 1/20
III	Infrequent Transients	< 1/20 – 1/100
IV	Design Basis	1/100 – 1/10,000
V	Special	N/A

The response to the transients shown in the previous categories is carried out using the Abnormal Operating Procedures.

Emergency Operating Procedures

An overview of the Emergency Operating Procedures structure and interrelationships is shown in Figure 19.1 It can be seen that there are twelve critical parameters controlled by the EOP: three for Reactor Control, five for Primary Containment Control, three for Secondary Containment Control and one for Radioactivity Release Control. Only three of them require transferring its control among different portions of the EOP, these are:

a) Reactor water level.

b) Reactor pressure.

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c) Suppression pool water level.

- **Establishment of procedures and guidelines to prevent severe accidents or mitigate their consequences and establishment of procedures and guidance to manage accident situations at multi-unit nuclear installations and/or multi-facility sites;**

At this time, LVNPS is updating its emergency procedures and implementing its Severe Accident Management Guidelines, based on the BWR Owners' Group's emergency procedure and severe accident guidelines (EPG/SAG Rev. 3's).

- **Regulatory review and control activities**

CNSNS used in 1992 the guidelines established in NUREG/CR-2005, Rev.1, "Checklist for Evaluation of Emergency Operating Procedures Used in Nuclear Power Plants" in order to verify the proper implementation of the EOP in the LVNPS simulator.

During the 2013-2015 period, CNSNS performed inspections to the Operation and Training Departments, and conducted operation examinations to the licenced personnel in the simulator, both to grant new Reactor Operator (RO) licences and renew the licences of ROs and Senior Reactor Operators of LVNPS. During these activities, which are scheduled annually, in relation to the Emergency Operating Procedures, it was verified that:

a) If there were significant changes to the EOP, LVNPS should meet the regulatory commitments and requirements.

b) If there were significant changes to the EPG of the BWR owners group, LVNPS's procedures were technically suitable for incorporating these changes, and that any deviation from the EPG was completely justified.

c) The entry and exit conditions from the EOP were easy to follow, and that the transition among the normal, abnormal and emergency operating procedures was properly defined and that could be easy to follow.

d) The use of the notes and cautions of the EOP was consistent and correct.

e) The Reactor Operators and the Senior Reactor Operators received the training required before the changes to the EOP were implemented for application in the Main Control Room.

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Article 19 (5) Engineering and technical support

- **General availability of necessary engineering and technical support in all safety related fields for all nuclear installations, under construction, in operation, under accident conditions or under decommissioning**

  LVNPS has an engineering office that provided technical support during the construction and commissioning phases of the two units. Currently, this office provides continuous technical support to maintain the design bases, and safe and reliable operation of systems, equipment and components of LVNPS Units 1 and 2.

- **General availability of necessary technical support on the site and also at the licence holder or utility headquarters, and procedures for making central resources available for nuclear installations**

  The engineering office has a group of Systems Engineers and another group of Programmes and Components Engineers, in addition to a dedicated group for the on-site documents and procedures control. This structure allows providing the immediate or short term technical support required by the LVNPS units. There is another off-site group of Engineering for the Design and Maintenance of Documentary Configuration to maintain the plant safety in the medium and long terms.

- **General situation with regard to dependence on consultants and contractors for technical support to nuclear installations**

  Although the LVNPS Engineering Office has all the design documentation, including: architectural and engineering drawings, calculation logs, technical drawings, procurement technical specifications, etc., which is necessary to provide an independent technical support, a close and professional partnership with General Electric Company has been maintained. General Electric was responsible for the design, manufacture and delivery of the Nuclear Steam Supply System (NSSS) for both LVNPS units and provided consulting during the construction and commissioning of equipment. As of to date, General Electric provides technical support for the NSSS. The turbine generator set originally installed in LVNPS units was designed, manufactured and delivered by Mitsubishi Heavy Industries. Mitsubishi Heavy Industries supported all the time the modifications and major maintenance while its equipment was in operation. Now with the Extended Power Uprate project for a power uprate up to 120% of the RTP, the turbo-generator set of both LVNPS units was replaced by ALSTOM company equipment. ALSTOM company is also providing technical support, similar to the one provided by Mitsubishi Heavy Industries. In addition, the company URS, Washington Division (formerly Ebasco Co.), was the Architect/Engineer for the design, construction and testing of both LVNPS units. URS continues providing technical support to CFE in the assessments and design changes.

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- **Regulatory review and control activities**

  As mentioned in Article 14, CNSNS verifies annually the Engineering and Technical Support areas through its Baseline Inspection Programme. During refuelling outages, CNSNS also verifies that the service suppliers meet the following: their Quality Assurance Programmes or they are included in LVNPS's QAP; comply with the training and qualifications required for the activities that will develop; and the Radiation Protection and Industrial Safety controls established by LVNPS.

Article 19 (6) Reporting of incidents significant to safety

- **Overview of the Contracting Party's arrangements and regulatory requirements to report incidents significant to safety to the regulatory body**

  According to the regulatory framework, LVNPS must report to CNSNS the occurrence of all incidents covered by categories defined in 10 CFR 20.2202, 10 CFR 20.2203, 10 CFR 50.72 and 10 CFR 50.73 using the format identified as Notification of Reportable Event (NRE). Such format includes a summary of the event; immediate corrective actions; core emergency cooling system and engineering safeguards system conditions; as well as information on radiological conditions as applicable.

  This notification is sent to the on-site CNSNS Resident Inspector at LVNPS as well as to CNSNS's headquarters, according to the incident safety significance. The notification shall be sent immediately, within one hour or within four hours after the event.

  LVNPS must send a Licensee Event Report (LER) within 30 days of the occurrence of the event, completely describing the event, the result of the root cause analysis and corrective and preventive actions proposed.

- **Overview of the established reporting criteria and reporting procedures for incidents significant to safety and other events such as near misses and accidents**

  The notification and reporting of the LVNPS safety important events are carried out according to the notification and reporting criteria set in Procedure PAS-07 "LVNPS Event Notification and Reporting to CNSNS". This procedure is based on 10 CFR 20.2202, 10 CFR 20.2203, 10 CFR 50.72, 10 CFR 50.73, and NUREG-1022 "Event Reporting Guidelines: 10 CFR 50.72 and 50.73".

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– Statistics of events important to safety for the past three years

Figure 19.2 shows a plot for the events that have occurred in both LVNPS units from the start of operation through 2015.

The most important events at LVNPS during the 2013-2015 period are described below.

1. On January 11, 2013, Unit 1 was operating at 87.5% RTP, when the condensate demineralizers and filters system (G16) was isolated, which decreased power to 70% and resulted in a manual reactor SCRAM. This was the result of a broken screw in an electrical distribution panel; the screw supported the neutral lug of the panel. This led to a loss of electrical stability in the loads supplied by the panel, causing a voltage imbalance and isolation of the programmable logic controller (PLC). Then the condensate booster pumps tripped, reducing the power to 70%, and a manual SCRAM was performed.

   One of this filter system's functions is to maintain high condensate purity through a continuous ionic exchange process. The root cause of the event was: a) the procedure has very generic instructions that don't include critical tasks of monitoring the panel, and b) weaknesses in preventative maintenance and compensatory actions.

2. On February 23, 2013, Unit 1 was operating at 87.5% RTP, when an automatic reactor SCRAM occurred because the main generator tripped. The high differential pressure alarm in port A of filter 1-GSOS-ST-011 was triggered. In order to clean port A's filter element, port B was put into service, but a high differential filter pressure (at the top of the scale) occurred, decreasing the differential pressure of the generator oil seals and reaching the trip value of the main generator (0.2 bars), thus tripping it and sending a SCRAM signal to the reactor. The root cause of this event was inadequately managing filter replacement and work practices that didn't encourage a questioning attitude and assessing while performing actions.

3. On May 5, 2014, Unit 1 was in shutdown mode and leak testing the reactor vessel at a pressure of 1.3 kg/cm^2, when the reactor was isolated because of high flow in the residual heat removal (RHR) system, while in cooling mode during shutdown, and the trip of pump 1RHR-P-001A, which was in service, triggering the high suction flow alarm and closing valve 1-RHR-MV-8248.

   The root cause of this event was written communication with technical inaccuracies, because the instruction in the procedure did not indicate that the impulse line for the high-pressure differential instrument had to be vented and filled.

4. On May 13, 2014, Unit 1 was operating at 87.5% RTP, a manual SCRAM of the reactor was performed because of a "Fryquel" oil leak in the Electro Hydraulic Control (EHC) system. The leak was detected when the EHC 1A pump tripped because of low level in the EHC tank. Inspection of the EHC system components detected a leak through the

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lower flange of the 1-EHC-TK-012 tank. It is inferred that during the implementation of a modification package, the flange's O-ring was damaged.

The root causes of the event were improper work practices and not following documents correctly.

5. On December 14, 2014, Unit 1 was operating at 87.5% RTP, when there was an alarm for high flow of the OFF-GAS system, and the main condenser started to lose vacuum. A manual SCRAM of the reactor was performed to avoid enter the restricted area of load vs. vacuum graph of the main condenser. After the SCRAM, a search of the air entrance to the main condenser was initiated. A damaged pipe was found at a a 3" x 1.5" reducer that is welded to a restricting orifice; this pipe discharge to the condenser. The root cause of the event was from not monitoring the failed component, although it had been contemplated to replace it as part of the erosion-corrosion programme planned for the 17th Refuelling Outage of Unit 1.

6. On June 29, 2015, Unit 1 was operating at 87.5% RTP, when there was a momentary loss of EPL communication in CPU "B" of the digital electro hydraulic control (DEHC) system. EPL are field devices that provide input and output information to the DEHC. At that moment, CPU "B" was serving as the master control for the turbine. The communication loss resulted in a SCRAM of the reactor from turbine trip.

   The most probable cause was a functional deficiency in the design of the system or component. The failure of a component that is part of the DEHC's redundant communication architecture prevents the system from recovering and continuing to control the turbine-generator.

7. On July 9, 2013, at 01:45 hours, Unit 2 was operating at 87.5% RTP, when there was an automatic reactor SCRAM by activation of main generator differential protection relay 286/G2. The 400 kv switches tripped, and there was a satisfactory transfer of auxiliary services to the reserve transformer. The search for the failure found oil in some cables, a consequence of an earlier spill in the main generator's oil system.

   The root cause of the event was poor supervision.

8. On April 10, 2014, Unit 2 was operating at 87.5% RTP, when the main turbine speed channel alarm was triggered, causing an automatic reactor SCRAM. The failure mode of this hardware caused a mismatch in the turbine control systems' logic with the operating condition; the channel failure was processed as an off signal in the logic segment of turbine start-up, causing an unexpected operation of the control system, leading to shutdown mode of the turbine. This resulted in the following sequence of events in the transition: 1) closing of governing valves, 2) increase in reactor pressure, 3) SCRAM because of high neutron flux, 4) opening bypass pressure-control valves, and 5) turbine trip by load rejection.

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The root cause of the event was deficient functional (logic) design of the system or component.

9. On May 14, 2014, Unit 2 was operating at 87.5% RTP, when there was an automatic turbine trip and subsequently a reactor SCRAM. The trip was caused by the presence of a spurious signal from two open switches that were received from the 400 kV substation.

   The root cause of the event was incorrect assembly instructions in the equipment's fabrication/installation specification.

10. On July 12, 2014, during Unit 2's 13th Refuelling Outage, execution of the "functional logic test of the emergency core cooling system (ECCS)" procedure was authorized. At one point, the procedure indicates the placement of jumper cables in given order, and in a subsequent point it indicates the removal of the same jumper cables, but in the reverse order. The technician removed the jumper cables in the same order they were installed, which led to the start-up of the Division I diesel generator and the isolation of group 8 because of human error, which at the time, was caused by weaknesses in the drafting of the procedure.

    The root cause of this event was the presentation method of written communication, with poor information or references. The procedure contains unnecessary reference instructions to other procedure steps, creating confusion in the technical staff.

11. On October 20, 2014, Unit 2 was operating at 50% RTP, when an automatic SCRAM was triggered by the trip of main transformer T-2. An inspection of the transformer area, a pressure relief valve was found to have been used to vent an isolation oil over-pressure, which caused the activation of the valve's micro-switch, and in turn sent a signal to a relay, causing Unit 2 to drop off the national electric system grid.

    The root cause of the event was the content of written communication, specifically the omission of relevant information from the maintenance procedure.

12. On May 12, 2015, Unit 2 was operating at 97.4% RTP, when an automatic reactor SCRAM occurred when the turbine was tripped by activation of a relay. On May 19, 2015, another automatic reactor SCRAM was caused when the turbine was tripped by activation of the same relay.

    The most probable cause was the possible deficiency in the construction/materials of these components. In the second event, the fuse did not activate, a possible deficiency in the construction/materials or not reaching the fuse's activation current.

13. On October 15, 2014, during a programmed shutdown of Unit 2, loop B of the Residual Heat Removal (RHR) system was being prepared to be put into service in shutdown cooling mode. The order was given to start the pump and flow to the system through the discharge valve activated the instrument that monitors for high differential flow in the

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suction, causing the suction valve to close and consequently the pump to trip. During the search for the failure, a system relief valve actuated.

The root cause was work practices, documents, or procedures not being followed correctly.

14. On May 22, 2015, Unit 2 was in shutdown mode, after the SCRAM initiated by turbine trip (Event 12 above), isolation of the Residual Heat Removal (RHR) system occurred in shutdown cooling mode, caused by human error de-energizing Reactor Protection System (RPS) "B."

    The root cause was the combination of scheduling of work; decreased alertness; fatigue and work practices; document use practices; and/or documents or procedures not followed correctly.

As part of the measures taken in response to these events, the following results were obtained: 1) Strengthening of the adherence to procedures, 2) Improvements to procedures, 3) Strengthening of human performance tools, 4) Design changes, 5) Replacement of damaged components, 6) Feedback from the internal operating experience and retraining programmes, and 7) Improvement of inspection plans based on the industry guidelines.

- **Documentation and publication of reported events and incidents by both the licence holders and regulatory body**

Licence holders

The notification and reporting of LVNPS safety significant events are done through the Licensee Event Reports which are sent to CNSNS in accordance with the regulatory provisions.

Also, LVNPS shares its operational experience with the international nuclear community through the World Association of Nuclear Operators (WANO), which publishes the most significant operational events.

Regulatory body

CNSNS participates in the International Reporting System for Operating Experience (IRS) meetings jointly hold by the IAEA, Organization for Economic Co-Operation and Development's (OECD) Nuclear Energy Agency (NEA) and the IAEA International Nuclear and Radiological Event Scale (INES). The participation objective is to share operational experience of the Mexican nuclear installation with member countries of the international community, and to collect and implement the international experience in the Mexico.

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- **Policy for use of the INES scale**

  An operational event that causes a special inspection and has an INES Level 2 or higher shall be informed to the IAEA INES system.

- **Regulatory review and control activities**

  CNSNS assesses the Licensee Event Reports presented by CFE to verify that they were prepared in compliance with the regulatory framework. When a safety significant event or safety special interest event occurs at LVNPS, CNSNS performs an in-depth assessment and investigation of the causes that originated the event and the existence of recurrent events; and, when required, questions or imposes the corrective actions scope and/or the completion due date. For the analysis of the reportable events, CNSNS prepares statistics to identify trends on the type of event, root causes, recurrences, etc., in order to determine the need to implement any regulatory action, as a result of the statistical analysis.

  As mentioned in Article 14, in 2009 CNSNS started categorizing the operational events according to their safety significance. This exercise has the purpose of determining performance indicators similar to USNRC Reactor Oversight Process (ROP) Performance Indicators to compare LVNPS performance with similar plants and emulate the best international practices. Additionally, several administrative procedures were developed including those for Class I, II and III reactive inspections, depending on the level of response required by the safety significance of the event. These procedures assure a systematic, comprehensive and predictable response from CNSNS.

Article 19 (7) Operational experience feedback

- **Overview of the Contracting Party's arrangements and regulatory requirements on the licence holders to collect and analyse and share operating experience**

  The commercial operation licence states that LVNPS shall continue with the feedback from the national and international operational experience and implement changes to relevant legislation that CNSNS considers applicable and within the deadlines established according to the changes size, to increase safety and, public and environment protection.

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- **Overview of programmes of licence holders for the feedback of information on operating experience from their own nuclear installation, from other domestic installations and from installations abroad**

Introduction

The programmes for both the internal and external operational experience feedback are carried out according to the guidelines set in Procedure PAS-18 “Programme for Reviewing External Operational Experience of the Nuclear Power Plant’s Division” and Procedure PAS-26 “Activities of the Operational Experience Programme".

External operational experience

CFE’s Procedure PAS-18 provides the methodology, guidelines, and scope of the external operational experience review process; also describes each stage of the process and the people responsible; and the interfaces between different organisations involved in the review process.

The review process begins with an information search of events that have occurred in the nuclear industry and non-nuclear industry. This search is carried out mainly on the websites of the Institute of Nuclear Power Operations (INPO), the World Association of Nuclear Operators and the United States Nuclear Regulatory Commission. The procedure differentiates two types of documents: those that are just for information (e.g., guides, best practices, etc.); and those that document events that require an evaluation to determine if similar events could happen at LVNPS. The first type of documents are translated into Spanish and disseminated to LVNPS staff through the intranet, newsletters, e-mail, posters, and presentations in supervisor and working group meetings. For the documents that require an evaluation, a preliminary screening is carried out to identify events potentially applicable to LVNPS. These events are assigned to specialists for a detailed review and accurately determine if similar events could happen at LVNPS. If that is the case, actions to prevent their occurrence are implemented. The reports of the most significant events are reassessed every 6 years to determine whether the actions initially implemented continue to be valid or additional actions are necessary.

Internal operational experience

Regarding the internal operational experience, the events at LVNPS are documented in the Corrective Action Programme. The events are reviewed by specialists of the corresponding technical area, who define and implement the corrective actions to prevent occurrence of similar events.

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- **Procedures to analyse domestic and international events**

The analysis of LVNPS internal events is performed according to the Procedure PAG-46 "Analysis of Events." This procedure provides guidelines and instructions to determine the root cause, the apparent cause or the direct cause of the events, depending on the significance level assigned to them based on the criteria of Procedure PAG-71 "Corrective Action Programme". The root cause is determined for events classified as levels 1 and 2 (reported to CNSNS); the apparent cause is determined for level 2 events; and the direct cause is determined for level 3 events. The methodologies of Procedure PAG-46 used for the research and analysis of the events are: Job Task Analysis, Cause-and-Effect Analysis; Event Trees and Causal Factors Analysis; Tap Root Analysis; Fault Tree Analysis, Change Analysis, Barrier Analysis; and Human Performance Assessment. The methodology used depends on the complexity and nature of the event, using the summary of different methods provided in Procedure PAG-46) as an aid. More than one methodology may be used.

The events in foreign power stations are evaluated following the guidelines and instructions of Procedure PAS-18 "Review Programme of External Operational Experience of the Nuclear Power Plant's Division." Taking into account that these events were analysed and the actions to prevent their recurrence were defined using the procedures of the such foreign plants in which they occurred, or if they were significant generic events that occurred at several plants and the analysis was performed by INPO/WANO, the LVNPS evaluation is performed from the prevention perspective to determine if similar events could happen at LVNPS. In such cases, if the appropriate prevention barriers are not in place or are missing, they are implemented.

- **Procedures to draw conclusions and to implement any necessary modification to the installation and to personnel training programmes and simulators**

Internal and external operational experience is analysed to determine the real or potential impact of said experience at LVNPS, and consequently, take preventive actions. This analysis is carried out by the department that would be responsible if a similar event occurred at LVNPS. The department determines the appropriate actions. Modifications to the installation are made according to the administrative procedure PAG-74. Generally, corrective and preventive actions are logged and controlled through the Corrective Action Programme. Often the corrective actions result in changes to the plant, processes, and/or training programmes, including simulator training (full scope and process). Such changes are made in accordance with procedures EP-9152, EP-9221, and EP-9159 that govern the training of licenced and non-licenced personnel, and procedures EP-9178, EP-9219, and EP-9220 for the management of simulator changes and testing.

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- **Mechanisms to share important experience with other operating organisations**

The mechanisms for sharing important experiences with other organisations are established in CFE's Procedure PAS-26 "Activities of the Operational Experience Programme". This procedure sets the criteria to select or define what LVNPS operational events should be shared with other organisations. These criteria are the same ones set in WANO's "Operating Experience Program Reference Manual", which are applicable to all nuclear power plants. The WANO's reference manual is followed regarding the event reports content and format, and the event index system used for Category, Consequences, Systems, Components, Condition, Activity, Group, Direct Cause, Root Cause and Causal Factors.

- **Use of international information databases on operating experience**

The main databases of information on operational experience of events that have occurred in plants of other countries used in LVNPS include those of the Institute of Nuclear Power Operations, the World Association of Nuclear Operators, the US Nuclear Regulatory Commission, and NEA/OCDE International Reporting System for Operating Experience.

- **Regulatory review and control activities for licence holder programmes and procedures**

As mentioned in Article 14, CNSNS verifies every two years the external operational experience through its Baseline Inspection Programme. Also, during the inspections carried out to different safety-related areas it is performed a systematic follow-up of the internal operational experience and the feedback to all staff. Additionally, the inspection to the Corrective Action Programme includes a follow-up to the trend analysis and self-assessments performed by LVNPS staff, related with internal and external operational experience.

CNSNS's staff reviews the operational experience documented in the generic letters and bulletins issued by the USNRC, and forwards to LVNPS any applicable one that requires a response from the installation.

- **Programmes of the regulatory body for feedback of operational experience and the use of existing mechanisms to share important experience with international organisations and with other regulatory bodies**

As mentioned earlier, in Article 19 (6), CNSNS participates in the International Reporting System for Operating Experience and the International Nuclear and Radiological Event Scale (INES) meetings jointly hold by the IAEA and the Organization for Economic Co-Operation and Development (OECD) Nuclear Energy Agency (NEA). The participation objective is to share operational experience of the Mexican nuclear installation with member countries of

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the international community, and to collect and implement the international experience in Mexico.

Article 19 (8) Management of spent fuel and radioactive waste on the site

– Overview of the Contracting Party's arrangements and regulatory requirements for the on-site handling of spent fuel and radioactive waste

Regarding the spent fuel, LVNPS originally adopted the strategy to store all the spent fuel generated during the useful lifetime of both units in the Spent Fuel Pool (SFP), one pool per unit. The applicable requirements relating to radiation safety associated with spent fuel management are those stated in the General Regulation for Radiation Safety. The applicable requirements for the pools and support system design are the requirements established in Parts 20, 50, 71, 72, 73, and 100 of Title 10 "Energy" of the US Code of Federal Regulations (CFR).

To date, for the on-site spent fuel dry storage project at LVNPS, CNSNS issued a regulatory framework based on the following USNRC laws and regulations:

- 10 CFR 72: Licensing requirements for the independent storage of spent nuclear fuel, high-level radioactive waste, and reactor-related greater than class C waste.
- Regulatory Guide 3.48 Rev. 1: Standard format and content for the safety analysis report for an independent spent fuel storage installation or monitored retrievable storage installation (dry storage).
- Regulatory Guide 3.50 Rev. 1: Standard format and content for a licence application to store spent fuel and high-level radioactive waste.
- NUREG-1567: Standard review plan for spent fuel dry storage facilities.

With regard to the radioactive waste, the current regulation based on the General Regulation for Radiation Safety, applicable to the radioactive waste management at nuclear installations is the following:

NOM-004-NUCL-2013	Classification of radioactive wastes.
NOM-008-NUCL-2011	Radioactive contamination control.
NOM-018-NUCL-1995	Methods for determining the activity concentration and total activity in radioactive waste packages.
NOM-035-NUCL-2013	Criteria for the disposal of radioactive waste.

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NOM-036-NUCL-2001 Requirements for radioactive waste treatment and conditioning installations.

In addition to the Mexican Official Standards (denominated "NOMs") just mentioned, the radioactive waste management shall comply with the applicable requirements relating to radiation safety stated in the General Regulation for Radiation Safety and the applicable regulation.

- **On-site storage of spent fuel**

The Spent Fuel Pool (one per LVNPS unit) was originally designed in 1972 for a capacity of just 580 fuel assemblies, equivalent to an 18-month fuel cycle (1.3 times de core capacity). Towards the end of 1989, analyses were performed for the final arrangement of fuel racks in the SFP, based on the use of steel racks having special receptacles to retain Boron. LVNPS submitted these analyses to CNSNS, which after evaluating the heat removal capacity from the SFP cooling systems as well as the sub-criticality factor, granted authorization to increase the capacity of each Spent Fuel Pool to up to 7.16 cores (3,177 fuel assemblies), from which 6.16 cores (2,733 assemblies) are designated for routine storage and a complete core for emergency situations.

As a result of the licence renewal project, the useful life of LVNPS Units 1 and 2 will be increased. Their continued operation will generate more spent fuel than originally planned, requiring that spent fuel continue to be stored in the spent fuel pools (SFP).

Because the SFP were not designed with sufficient capacity to store the spent fuel that will be generated during the plant's useful life, now considering the enhanced power uprate (EPU) modification and the licence renewal for both units. This points to the need to augment LVNPS's capacity for spent fuel storage until it is moved to a permanent disposal site. Therefore, in 2015-2016 an Independent Spent Fuel Storage Installation (ISFSI) is being built at LVNPS site.

The purpose for building this facility is to increase the installed capacity of spent fuel storage of both LVNPS units. The first transfer "campaign" will be 20% spent fuel from the reactor building to the ISFSI, finally reaching 11,523 spent fuel assemblies in the ISFSI. With this, the SFP for both units will be completely empty at the end of LVNPS's useful life.

The service life of the HI-STORM FW storage container system, adapted by CFE for LVNPS, is 100 years, meeting the requirements of 10 CFR 72, and thus permitting the spent fuel to be stored until its final disposition is determined, even when the decommissioning of Units 1 and 2 has begun.

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- **Implementation of on-site treatment, conditioning and storage of radioactive waste**

Liquid waste treatment

The liquid waste collected comes from different sources, so they are divided as follows: equipment drains, floor drains, regeneration and chemical drains, detergents and laundry drains, and miscellaneous drains.

The treatment process is carried out in batches, maintaining a surveillance and control of the chemical quality through analysis and sampling. The specific actions depend upon the two following activities:

a) For recycling, LVNPS procedures set the chemical parameters that need to be complied with.

b) For release to the environment, the radioactive material is analysed to ensure that any discharge is As Low As Reasonably Achievable (ALARA) and in conformance with the requirements specified in 10 CFR 20 and 10 CFR 50, including the dose design objective specified in 10 CFR 50 Appendix I.

LVNPS implemented a new treatment system using "Reverse Osmosis Technology" to improve the radioactive waste processes as part of the ongoing continuous improvement effort. The filtration system can treat, at LVNPS, all high conductivity and high activity liquid waste collected in the radioactive waste and purification buildings to obtain chemically pure water which can be reused in the water-steam cycle. The two stage reverse osmosis system uses Backwash Flow Filters (BFFs), coal beds, ion exchange resins, and Ultra Filtration (UF).

Gaseous waste treatment

The gaseous treatment systems are designed according to the origin and radiation levels expected in the following LVNPS extraction and ventilating systems: Radioactive Gaseous (off-gas) Waste Treatment System, the Turbine Gland Seal System and Ventilation Systems of different process buildings of the installation.

It has been verified that the off-gas treatment system is designed to collect and delay exhaust of noble gases produced by fission, which are removed from the condenser by means of steam jet ejectors. The noble gas process continues through a heater, a hydrogen recombiner, a condenser, two 10-minute retention tanks, and a pre-filter system, activated carbon beds and high-efficiency air filters, and finally, through a ventilating air current, which is monitored before being sent to the atmosphere.

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This hydrogen recombiner system is designed to support postulated hydrogen (generated by radiolysis) explosions. It has alarms that actuate if a high concentration is detected, which alert the Main Control Room operator to isolate the faulty recombiner and put the redundant train into service.

Environmental dosimetry studies performed considering LVNPS in operation have demonstrated that design basis assumptions of gas treatment systems are adequate. Based on the above, it is considered that gas treatment satisfies its function of limiting the release of radioactive material in a gaseous form.

Solid waste treatment

This subsystem is designed to collect and process humid and dry solid waste generated at LVNPS to confine them in a safe and reliable manner inside containers appropriate for its eventual isolation. These can be stored in steel containers or high density polyethylene high-integrity containers (HICs).

The solid waste processing is controlled by the guidelines of the LVNPS Process Control Programme (PCP), which complies with the Technical Specifications, 10 CFR 61 and NOM-019-NUCL-1995 (see Annexe 7.3).

The wet solid wastes are treated by the cyclical draining process inside a high-integrity container where the free water content is reduced to less than 1% by volume.

The dry solid wastes can be treated by one of the following processes:

a. For the compactable waste, hydraulic compressing with 4:1 compacting ratio.
b. For non-compactable waste, direct packaging.

The sources of wet solid waste are: spent ion exchange resins, sludge of the phase separators, concentrated chemical laboratory waste, regeneration and decontamination solutions. The sources of dry solid waste include: cartridge filters, clothing, paper, plastics, thermal insulation, sand, grit and contaminated replacement components.

The drums and high-integrity containers with high-level radioactive waste already processed coming from both LVNPS units are initially stored in the decay area, within the Radioactive Waste Building. Later the drums and containers are transferred to the temporary on-site storage, which is located in the facility site.

The polyethylene or steel-shell polyethylene HICs and the steel drums are manufactured with radiation resistance, structural strength, and corrosion resistance, and are consistent with the requirements for seismic design and quality assurance.

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LVNPS has three areas for temporary storage of radioactive solid waste:

1. In-plant temporary storage. It is inside the Radioactive Waste Building, with storage capacity for HICs and steel drums of 55 gallons, for wet and dry solid waste for two years of waste generation.

2. On-site Temporary Storage. It is outside the double fence area but on-site, to store HICs and steel drums of 55 gallons for wet solid waste. The storage has 2 industrial warehouses; warehouse number I is completely full and warehouse number II has begun to receive HICs from the operation of both LVNPS units.

3. Dry Solid Radioactive Waste Repository. It is outside the double fence but on-site, to store steel drums of 55 gallons for dry solid waste.

During LVNPS Unit 1 start-up, it was decided to design and build an On-site Temporary Storage installation for wet low and medium radioactive waste; since there was no final repository site. This On-site Temporary Storage was licenced as an extension of the storage area of the Radioactive Waste Treatment Building. This installation was constructed in 1991, with an initial storage capacity for 5 years of operation of both units, considering the original design output of waste. Based on the LVNPS policy for waste reduction, the waste treatment process was improved; and the storage area was restructured and its capacity was optimised, resulting in an increased storage capacity to accommodate waste up to 2007. The LVNPS wet solid waste storage installed capacity has increased with the construction of the industrial warehouse II at the On-site Temporary Storage, which is currently in operation.

Also, a “dry solid radioactive waste repository” was enabled and licenced in 1993 to have sufficient storage capacity for dry radioactive waste, which provides an optimised capacity through 2015, assuming a production similar to current volumes. In 2006, studies for the implementation of additional volume reduction methods were started to increase the storage capacity; since the storage is about to be full. In 2007, a super-compaction process was carried out, which reduced the volume by a factor of approximately 3:1 of 6,000 compactable solid waste drums.

As part of the continuous improvement effort, CFE installed a subsystem of the reverse osmosis system, which consists of a dryer and granulator that equally serves both LVPNS units and replaces the evaporators-extruders that have operated for 15 years. In addition, the subsystem technology reduces the final waste compacting ratio to 4:1. With these actions, CFE intends to maintain a reliable waste solidification and reduce the wet solid waste volume. The purpose of this subsystem is to treat the concentrated liquid waste generated during the different stages of the filtering process and the concentrates produced by the waste evaporator system, in order to obtain a dry solid waste with moisture of less than 1 %. The dry solid waste will be packed in 55-gallon drums for its final disposal.

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The unusable reactor tools and components, such as depleted control rod blades, pitted fuel rods, etc., are stored in the Spent Fuel Pool.

Spent Fuel Storage

The ISFSI is designed to store spent fuel from commercial operation of LVNPS Units 1 and 2, taking into account the life extension resulting from licence renewal. Its purpose is to store the spent fuel assemblies in a safe and reliable manner in suitable containers, which subsequently can be used during transportation to the final disposal site. The HI-STORM FW container system consists of a multi-purpose container (MPC) within an outer casing made of steel and concrete. The outer casing has penetrations in the bottom to allow air circulation to cool the MPC, and therefore, the spent fuel contained within it. In addition, the MPC has a thermal siphon capacity that allows cooling of the fuel assemblies through the flow of helium in the container. The MPC consists of a basket that holds the fuel assemblies. The basket is made of neutron-absorbing material called Metamic-HT, with properties that ensure control of temperature, reactivity, and structural performance.

The spent fuel storage complies with the technical specifications for the ISFSI, 10 CFR 72, and the standards NOM-004-NUCL-1994 and NOM-035-NUCL-2000.

- **Activities to keep the amount of waste generated to the minimum practicable for the process concerned, in terms of both activity and volume**

In relation to LVNPS radioactive waste generation minimising processes, several strategies are being put in place by CFE, including:

1. Separation of radioactive material and more efficient, cleaner and expeditious decontamination of tools and objects contaminated, in new separation and decontamination workshops.
2. For compactable solid radioactive waste, super-compacting and fragmenting; for not compactable waste, selective decontamination mainly of metallic waste.
3. Optimising the use of materials to maintain equipment, tools and items free of contamination.

- **Established procedures for cleaning of radioactive waste**

CFE has a Technical Manual for the Process Control Programme, which is mandatory as prescribed by Technical Specification 3/4.11.3. The manual objective is to ensure that the treatment and conditioning processes are carried out for all the different types of low-level solid radioactive waste generated at LVNPS, such as: spent resins, temporary resins, precoat sludge, sludge from cleaning, sludge concentrates, activated carbon, active dry and other wastes.

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- **Regulatory review and control activities**

As mentioned in Article 14, CNSNS verifies annually the Radioactive Waste Management through its Baseline Inspection Programme. In particular, the inspection verifies the radioactive waste confinement, stability and control at LVNPS installations dedicated to these activities.

Additionally, during the 2013-2015 period, relating to the radioactive waste management, the activities presented below were carried out.

LVNPS storages for radioactive contaminated materials

Due to the execution of the Extended Power Uprate project in both LVNPS units and since there is no installation with sufficient space and special structures for temporary storage of radioactively contaminated dry solid materials, CFE formally submitted to CNSNS authorisation the application to construct and operate five Storages for Radioactive Contaminated Materials (SRCMs, called AMAC in Spanish). Initially, the SRCMs would receive contaminated materials from the EPU project only; however, CFE reconsidered its position. to use the installations for temporary storage of radioactively contaminated dry solid materials, free from transferable contamination, generated anywhere at LVNPS, during normal operation, refuelling outages, and special projects.

As part of the regulatory control activities, the applications for the construction and operation of the SRCMs were assessed and authorized by CNSNS. As part of the review process, Requests for Additional Information (RAIs) were made, technical meetings were held between the staffs of CNSNS and CFE, and technical recognitions visits were made. The design characteristics of the SRCMs, the ventilation systems (HVAC), Fire Protection, electrical system, aspects of radiation protection and the decommissioning of the storages, among other issues, were assessed.

Subsequently CFE requested reconsideration of the use of LVNPS's SRCM 1 and SRCM 2, in order to temporarily store compactable and non-compactable dry solids, dry solid waste, as well as contaminated reusable materials and/or equipment from normal operation or special projects. The request was not granted by CNSNS, so currently SRCM 1 and SRCM 2 temporarily store only radiologically contaminated dry solid material, free of transferrable contamination, generated at LVNPS during normal operation, refuelling, and special projects.

LVNPS storage for radioactive contaminated materials called "4 Naves"

CFE informed CNSNS that no additional SRCMs would be constructed beyond the already-licenced SRCM 1 and SRCM 2. Considering, on the other hand, the need for sufficient space for temporary and safe storing of metal containers type B12, B25, ISO and other special forms for temporary storage of radioactively contaminated dry solid materials, free from

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transferable contamination (generated at LVNPS during normal operation, refuelling outages, and special projects); CFE requested authorisation for the reconditioning and operation of one LVNPS Storage for Radioactive Contaminated Materials called "4 Naves".

As part of the regulatory control activities, the applications for the reconditioning and operation of one LVNPS SRCM called "4 Naves" were assessed by CNSNS. As part of the review process, Requests for Additional Information were made, technical meetings were held between the staffs of CNSNS and CFE, and technical recognitions visits were made. The structural aspects of the installation and the improvement actions were assessed to ensure radiation safety while the radioactive contaminated materials remain stored in containers type B12, B25, ISO and other special forms. The electrical and fire protection systems were evaluated, as well as the procedures for the control of physical security, and radiation and industrial safety.

It is worth mentioning that SRCM 1, SRCM 2, and “4 Naves” are certified to operate until December 31, 2018.

On-site Independent Spent Fuel Storage Installation (ISFSI) at LVNPS

In July 2015, CNSNS, anticipating CFE’s application, issued the construction authorization for the facility to be located on the LVNPS grounds. This authorization was supported by evaluation of the respective safety analysis report and a focussed inspection of the construction process. In the period covered by this National Report, CNSNS began evaluating the application to operate the installation, and CFE expects to have received authorization in May 2016 to conduct the first transfers from LVNPS’s spent fuel pools to the new storage facility.

Also during 2014 and 2015, CNSNS evaluated the Safety Analysis Report, putting into consideration three private international companies that competed with CFE for its combustible material storage container technology to be adopted for the ISFSI.

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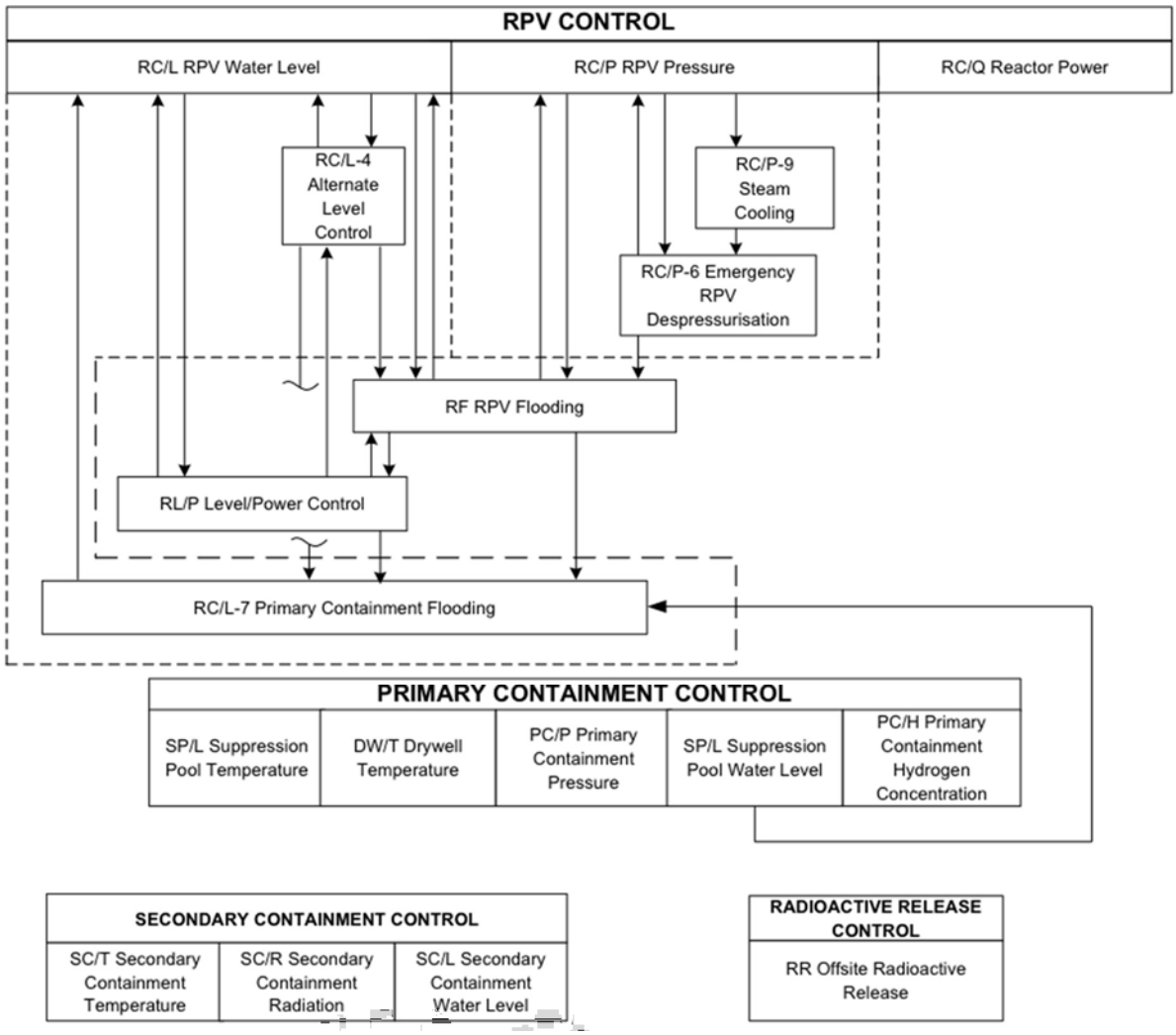

FIGURE 19.1 EMERGENCY OPERATING PROCEDURE STRUCTURE

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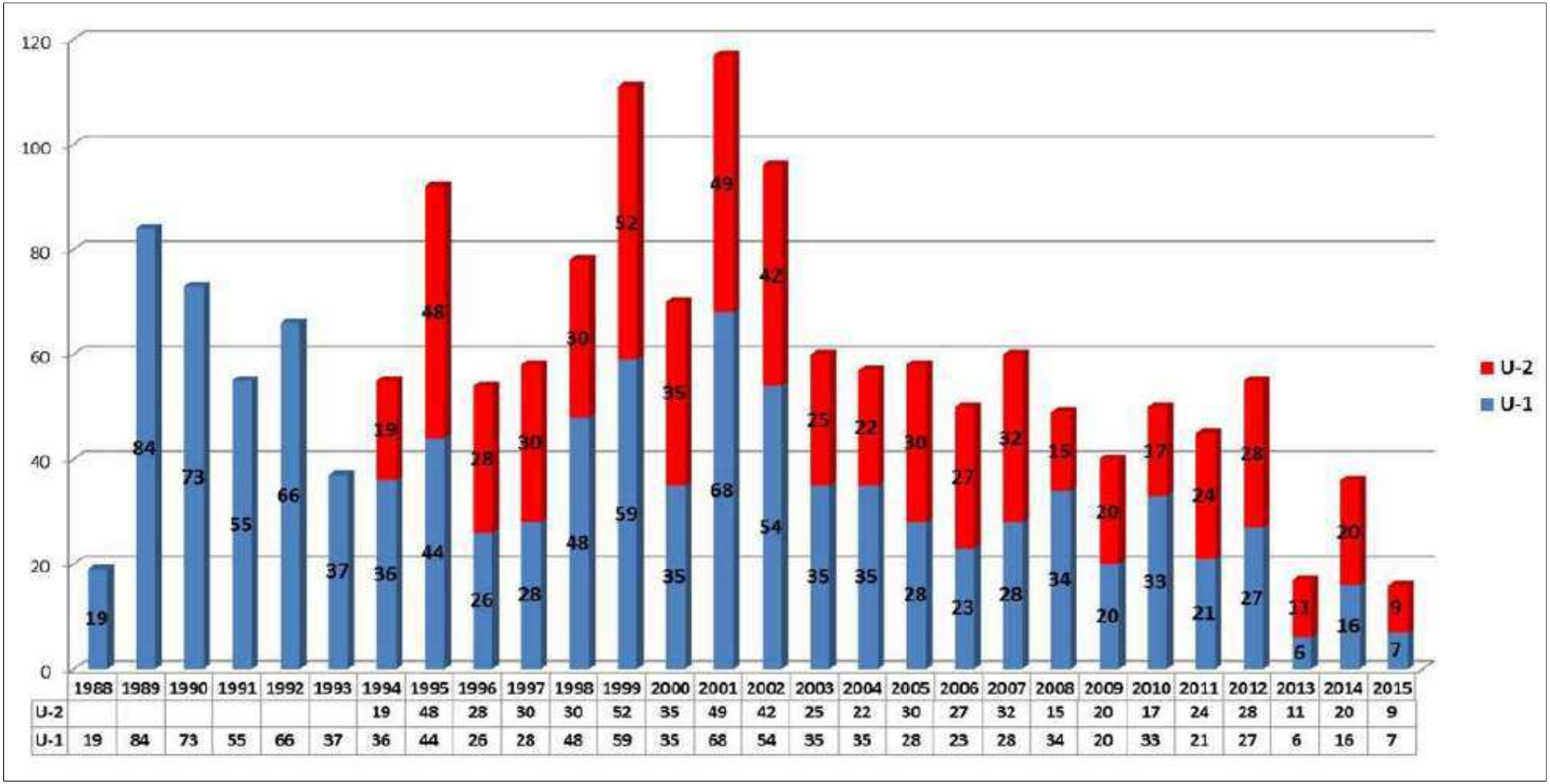

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
U-2							19	48	28	30	30	52	35	49	42	25	22	30	27	32	15	20	17	24	28	11	20	9
U-1	19	84	73	55	66	37	36	44	26	28	48	59	35	68	54	35	35	28	23	28	34	20	33	21	27	6	16	7

FIGURE 19.2 EVENTS SINCE START-UP THROUGH 2015 FOR LVNPS U-1 AND U-2

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