2015

INFORMATION SYSTEM ON OCCUPATIONAL EXPOSURE

[ISOE Country Reports]

Rev 5, 2017/07/10

FOREWORD

Throughout the world, occupational exposures at nuclear power plants have steadily decreased since the early 1990s. Regulatory pressures, technological advances, improved plant designs and operational procedures, ALARA culture and experience exchange have contributed to this downward trend. However, with the continued ageing and possible life extensions of nuclear power plants worldwide, ongoing economic pressures, regulatory, social and political evolutions, and the potential of new nuclear build, the task of ensuring that occupational exposures are as low as reasonably achievable (ALARA), taking into account operational costs and social factors, continues to present challenges to radiation protection professionals.

Since 1992, the Information System on Occupational Exposure (ISOE), jointly sponsored by the OECD Nuclear Energy Agency (NEA) and the International Atomic Energy Agency (IAEA), has provided a forum for radiological protection professionals from nuclear power utilities and national regulatory authorities worldwide to discuss, promote and co-ordinate international co-operative undertakings for the radiological protection of workers at nuclear power plants. The objective of ISOE is to improve the management of occupational exposures at nuclear power plants by exchanging broad and regularly updated information, data and experience on methods to optimise occupational radiation protection.

As a technical exchange initiative, the ISOE Programme includes a global occupational exposure data collection and analysis programme, culminating in the world's largest occupational exposure database for nuclear power plants, and an information network for sharing dose reduction information and experience. Since its launch, the ISOE participants have used this system of databases and communications networks to exchange occupational exposure data and information for dose trend analyses, technique comparisons, and cost-benefit and other analyses promoting the application of the ALARA principle in local radiological protection programmes.

This special edition of country reports presents dose information and principal events of 2015 in 29[*] out of 31 ISOE countries and will be incorporated into the Twenty-Fifth Annual Report of the ISOE Programme.

[*] Dose info and principal events of 2015 are not presented for Belarus and United Arab Emirates which do not have NPPs in operation (or decommissioning).

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INTRODUCTION

Since 1992, the Information System on Occupational Exposure (ISOE) has supported the optimisation of worker radiological protection in nuclear power plants through a worldwide information and experience exchange network for radiation protection professionals at nuclear power plants and national regulatory authorities, and through the publication of relevant technical resources for ALARA management. This special edition of country reports presents dose information and principal events of 2015 from 29[†] out of 31 ISOE countries and will be incorporated into the Twenty-Fifth Annual Report of the ISOE Programme.

ISOE is jointly sponsored by the OECD NEA and IAEA, and its membership is open to nuclear electricity utilities and radiation protection regulatory authorities worldwide who accept the programme's Terms and Conditions. The ISOE Terms and Conditions for the period 2012-2015 came into force on 1 January 2012. As of December 31st, 2015, the ISOE programme included 75 Participating Utilities in 29 countries (349 operating units; 57 shutdown units), as well as the regulatory authorities in 24 countries. The ISOE database includes occupational exposure information for over 400 operating units in 29 countries, covering about 90% of the world's operating commercial power reactors. Four ISOE Technical Centres (Europe, North America, Asia and IAEA) manage the programme's day-to-day technical operations.

In addition to information from operating reactors, the ISOE database contains dose data from over 80 reactors which are shut down or in some stage of decommissioning. As these reactor units are generally of different type and size, and at different phases of their decommissioning programmes, it is difficult to identify clear dose trends. However, work continued in 2015 to improve the data collection for such reactors in order to facilitate better benchmarking.

While ISOE is well known for its occupational exposure data and analyses, the programme's strength comes from its objective to share such information broadly amongst its participants. In 2015, the ISOE Network website (www.isoe-network.net) continued to provide the ISOE membership with a comprehensive web-based information and experience exchange portal on dose reduction and ISOE ALARA resources.

The annual ISOE ALARA Symposia on occupational exposure management at nuclear power plants continued to provide an important forum for ISOE participants and for vendors to exchange practical information and experience on occupational exposure issues. The technical centres continued to host international / regional symposia, which in 2015 included: the ISOE North-American ALARA Symposium organised by the North American Technical Centre in Fort Lauderdale (USA) on 12-14 January; the ISOE International ALARA Symposium organised by the IAEA Technical Centre in Rio de Janeiro (Brazil) on 26-27 May; and the ISOE Asian Symposium organised by the Asian Technical Centre in Tokyo (Japan) on 9-10 September. Regional and international symposia provide a global forum to promote the exchange of ideas and management approaches for maintaining occupational radiation exposures as low as reasonably achievable.

[†] Dose info and principal events of 2015 are not presented for Belarus and United Arab Emirates which do not have NPPs in operation (or decommissioning).

PRINCIPAL EVENTS IN PARTICIPATING COUNTRIES

ARMENIA

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
VVER	1	890
REACTORS DEFINITELY SHUTDOWN OR IN DECOMMISSIONING		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
VVER	1	*No separate data is available*

2) Principal events of the year 2015

Summary of national dosimetric trends

For the year 2015, the dosimetric trend at the Armenian NPP was decreased, and that was the result of good planning of the work in the controlled area, such as work with spent fuel removal and transportation, work with activated material in reactor equipment, non-destructive testing of pipes and effective planning of other controlled-area work during the outage, including decontamination work and the work with radioactive wastes.
The maximum individual dose was 17.3 mSv.
The collective dose for outside workers was 17 man·mSv. The value for outside worker dose is very small, because the facility operator has its own repair workers.
The collective dose for repair and outage was planned in terms of dose constraints, and the real doses constituted 79% of planned doses.

- *Events influencing dosimetric trends*

  No significant events (accidental situations) were registered for the impact on dosimetric trends.

- *Number and duration of outages*

  For 2015, one outage with a 85 (full refuelling) day duration was performed.

- *New plants on line/plants shut down*

  The new plant construction is on schedule. Siting considerations are currently ongoing and first preliminary results have been submitted to the Armenian Nuclear Regulatory Authority. The new safety improvement approaches in relation to the Fukushima-daiichi accident were considered in plant design regulatory requirements and site evaluation. The new regulations on site and design requirements were approved by the Government of Armenia and the requirements will be laid out in the bases for new design features.

- *Major evolutions*

  The “Dose reduction program including ALARA culture implementation” for 2015 was established, and improvement of the old radiation control system is almost finished. The new radiation control pass system is already in operation.

- *Component or system replacements*

  During the outage in 2015, no components or systems were replaced. In the frame of Life Time Extension (LTE) of the ANPP, modernization of some safety systems and components, including systems for radiation control and management, are foreseen.

- *Safety-related issues*

  Some safety related issues still exist due to medium activity radioactive waste treatment and storage activities. The preparation of a National Strategy for radioactive waste management in Armenia has been finished, and the NS is currently in approval stage at the Government. Major improvements in radioactive waste management are being implemented in the frame of LTE.

- *Unexpected events*

  For the year 2015, no unexpected events were registered.

- *New/experimental dose-reduction programmes*

  No new/experimental dose-reduction programmes were applied for the year 2015.

- *Organisational evolutions*

  Use of dose planning and the dose constraint approach for the reduction of individual doses of staff remain the main tools for ALARA implementation.

For 2016

- *Issues of concern*

  In 2016, the modification and modernization of some safety systems are being implemented due to the LTE and modernization program.

- *Technical plans for major work*

  1. Modernization of the Radiation Control System for airborne and liquid releases.
  2. Modernization and safety improvement measures for some safety systems (which are included in the LTE program).

- *Regulatory plans for major work*

  Review of Inspections procedures and special-work-related new Check list preparation for inspections at ANPP, to control compliance with license conditions, regulatory requirements and follow-up actions.

  To review the safety assessment report (SAR) for LTE in terms of radiation protection of workers and the public, and the safety of radioactive waste management, submitted by ANPP in their reports, and preparation of follow up action.

BELGIUM

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	7	320

2) Principal events of the year 2015

- *Events influencing dosimetric trends*

a) Unplanned shutdown for Doel 3 / Tihange 2 because of indications (hydrogen flakes) in the reactor vessel lasted until the end of 2015, after the Belgian Safety Authority gave the authorization to restart on November 17th, 2015.
b) As in 2014, concrete conditioning of the radioactive waste at Doel remains stopped, after the discovery of an unexpected alkali-silicate reaction. Licensing of the new process is in progress.
c) More extensive plant outages for Doel 1 & 2, from the perspective of long term operation (10 additional years), were authorized by the Belgian Government on Oct 9th, 2014.
d) Doel 4 and Tihange 3 outages with replacement of the vessel heads.
e) LTO stop Tihange 1: included a large amount of work for LTO (but without refuelling).
f) Detailed collective dosimetry (outage information):

2015	Doel 1	Doel 2	Doel 3	Doel 4	Tihange 1	Tihange 2	Tihange 3
Outage dates	1/3 - 31/12	2/5 - 18/5 23/10 - 25/12	1/1 - 21/12 25/12 - 31/12	28/8 - 17/10	20/6 - 15/9	7/9 - 16/10 18/11 - 14/12	24/3 - 10/5
Outage man·mSv	133.4	77.45 and 364.8	180.1	393.9	341.4	83.0	419.0
Total man·mSv	601.3		181.2	405.6	393.6	176.5	454.6

- *New/experimental dose-reduction programmes*

a) Not yet any observed impact from Zinc injection in the primary circuit of Doel 3.
b) Zinc injection will not be implemented at Tihange 2, unless a long term operation would be envisaged
c) Alternative initiatives taken to reduce the source term (ex. Ag110m issue)
d) Additional effort were made to minimize the “search” dose (dose accumulated while locating the equipment which requires maintenance)

- *Organisational evolutions*
  a) Additional test phases of RCA access using the Doel protocol (protective overclothes and not an entire change of clothes) during the year 2015. Full test expected during the next outage of Tihange 3 in 2016
  b) Progressive replacement of the personal electronic dosimeters at Doel, to be completed by mid-2016.
- *Regulatory requirements*

  National safety authority kicked off the project to revise the base regulation for protection against ionising radiations, following the publication of the Euratom BSS. This project is on-going.

BRAZIL

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	2	651.232 (Angra 1: 389.322 Angra 2: 261.91)

2) Principal events of the year 2015

- *Events influencing dosimetric trends*

  Outages information: Angra 1 - Days of planned outage: 59

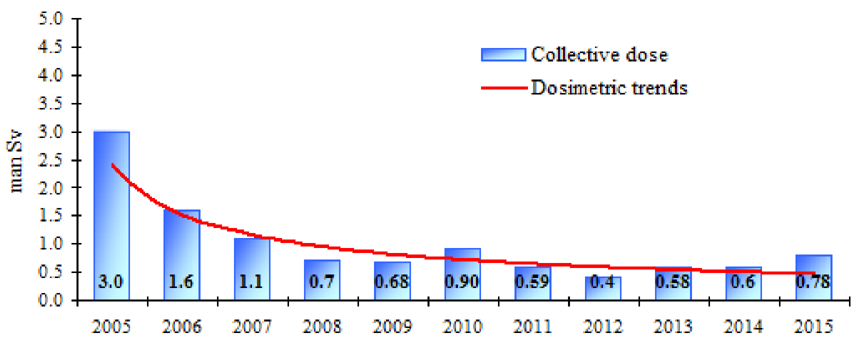
  Angra 2 - Days of planned outage: 30

BULGARIA

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
VVER-1000	2	377
REACTORS DEFINITIVELY SHUTDOWN OR IN DECOMMISSIONING		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
VVER-440	4	5.5

2) Principal events of the year 2015



Unit No.	Outage duration, days	Outage information
Unit 5	39	Refuelling and maintenance activities
Unit 6	54	Refuelling and maintenance activities

- *Events influencing dosimetric trends*

About 60% of the exposure of the workers in 2015 was due to implementation of two big projects – thermal power increase and life time extension of units 5&6. In this connection, a lot of modernization and refurbishment activities were performed on the unit systems in the RCA. Examples include the following:

- modernization of the steam generator separation system, planned in two stages – for unit 5 the first stage was finished on all SG, for unit 6 the second stage was finished on SG1 and SG4;
- modernization of the first circuit temperature measurement system;
- increased amount of radiographic inspection activities;
- thermal insulation replacement;
- systems and components inspection, etc.

CANADA

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
CANDU	19	830
REACTORS DEFINITIVELY SHUTDOWN OR IN DECOMMISSIONING		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
CANDU	3	70*

*Includes only those shutdown reactors that report occupational dose separate from operating reactor units or other licensed activities, i.e., Gentilly-2. The three shutdown reactors included Pickering 2, 3 and Gentilly-2.

2) Principal events in ISOE participating countries

For 2015 National dosimetric trends:

- 15.84 Person-Sv for 19 operating units in 2015;
- Average annual dose per unit 0.83 person-Sv in 2015.

The total collective effective doses and the average collective dose per unit at operating Canadian nuclear plants decreased slightly in 2015 (approximately 6%) from 2013. However, the trends remain steady since 2010. The decrease in occupational dose reflects the type of scope of work being performed and values are noted to be less than when refurbishment activities were ongoing at Pt. Lepreau and Bruce Power Units 1, 2.

The average calculated dose for 2015 includes nineteen (19) units. The dose associated with activities performed at two units in safe storage (Pickering Units 2 and 3) is negligible and therefore not included in the calculated average. Therefore, the dose is not reported separately but instead included under the operational Pickering Units. Gentilly-2 transitioned from an operational site to safe storage in 2013.

The implementation of ALARA initiatives at Canadian Nuclear Power Plants (NPPs) and improved work planning and control, continue to contribute to the reductions in the annual Canadian collective dose. Distribution of annual effective doses to workers at Canadian NPPs showed that approximately 85 percent of the workers received an annual effective dose below 1 mSv.

In 2015, approximately 89% of the collective dose was due to outage activities, and most of the radiation dose received by workers came from external exposure. Approximately 11 % of the dose received was from internal exposure, with tritium being the main contributor to the internal dose of exposed workers.

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3) Principal Events in Canada

Bruce Power A

In 2015, all four units were operational at Bruce A Nuclear Generating Station. Bruce A, Units 1-4 had 160 outage days in 2015. Outage work scope accounted for 92 percent of the total annual dose for Bruce A. Planned outage work scope included fuel inspection, boiler work, condenser repair, feeder repair, feeder replacement, Grayloc refurbishment and feeder replacement.

Routine operations accounted for approximately 8% of the total collective dose. Internal dose was approximately 5 percent of the total Bruce A collective dose. The 2015 internal dose was slightly lower than the 7% recorded in 2014. Internal dose ALARA initiatives in 2015 included reducing primary water heat transport leak rates and repairing vault vapour recovery dries.

Bruce A, Units 1-4 routine operations dose for 2015 was 0.376 person-Sv and the maintenance outage dose was 4,394 person-Sv (one planned outage and forced outages). The internal dose for Bruce A Units 1-4 was 0.260 person-Sv and the external dose was 4,510 person-Sv. The total collective dose for Bruce A Units 1-4 was 4,771 person-Sv which resulted in an average collective dose 1,192 person-Sv/unit.

Bruce Power B

Bruce B, Units 5-8 were operational in 2015 with a total of 110 outage days. Outage activities accounted for approximately 81% of the total collective dose. Planned outage work scope included feeder inspections in Unit 6 and a vacuum building inspection. Routine operations accounted for approximately 19 percent of the total station collective dose.

Bruce B, Units 5-8 routine operations dose was 0.505 person-Sv. The outage dose was 2,147 person-Sv in 2015. The internal dose was 0.155 person-Sv. The external dose was 2,498 person-Sv. The total dose was 2,652 person-Sv which resulted in an average collective dose 0.663 person-Sv/unit.

Darlington Units 1-4

In 2015, all four units were operational at Darlington Nuclear Generating Station with a total of 101 outage days. Outage activities accounted for approximately 88% of the total collective dose at Darlington. This is slightly higher than 2014 and reflect the scope and type of outage work scope. Planned outage work scope included feeder and boiler inspections in Unit 3 and a vacuum building inspection. Routine operations accounted for approximately 12 percent of the total collective dose.

Internal dose accounted for approximately 18% of the total collective dose, a slight increase from the internal dose of 15 percent reported in 2014. This increase can be attributed partly to increased airborne tritium levels in containment combined with a higher number of personnel making containment entries.

Darlington Units 1-4 had routine operations dose of 0.329 person-Sv. The total outage dose was 2.312 person-Sv. The internal dose for 2015 was 0.485 person-Sv. The external dose was 2.155 person-Sv which resulted in an average collective dose 0.660 person-Sv/unit.

Pickering Nuclear

In 2015, Pickering Nuclear Generating Station had six units in operation (Units 1, 4, 5-8), with a total of approximately 416 days outage days. Units 2 and 3 continued to remain in a safe storage state.

Outage activities accounted for approximately 87% of the collective dose at Pickering Nuclear Generating Station. Routine operations accounted for approximately 13% of the total collective dose.

Internal dose accounted for approximately 15% of the total collective dose, a slight decrease from the internal dose rate of 17% percent reported in 2014. This decrease can be attributed to the scope and type of work performed.

The routine collective dose for operational units was 0.747 person-Sv in 2015.

The outage dose for the operational units was 4.802 person-Sv. The internal dose was 0.821 person-Sv. The external dose was 4.728 person-Sv. The total dose was 5.549 person-Sv which resulted in an average of collective dose 0.925 person-Sv/unit.

The dose associated with radiological activities performed at Pickering Units 2 & 3 (in safe storage since 2010) is negligible when compared to collective dose of the operational units. Therefore, this dose is not reported separately but instead included under operational Pickering Units.

Point Lepreau

Point Lepreau is a single unit CANDU station. In 2015, Point Lepreau was fully operational with a total of 58 outage days. Outage activities accounted for approximately 35% of the total collective dose at Pt. Lepreau.

Internal dose accounted for approximately 20% of the total collective dose, which is a slight increase over 2014 (when internal dose was 15%). This increased dos contribution from tritium was due in part to a leaking fitting on the primary heat transport system. This fitting is scheduled for repair during a planned outage in the spring of 2016.

The routine collective dose for operational activities was 0.144 person-Sv in 2015.

The internal dose was 0.044 person-Sv. The external dose was 0.176 person-Sv. The total dose was 0.220 person-Sv.

Gentilly-2

Gentilly-2 is a single unit CANDU station. In 2015, Gentilly-2 continued transition from operation to safe storage state. The reactor was shut down in December 28, 2012.

There was a decrease in the collective doses at Gentilly-2 because the majority of radiological work activities with the transition form an operational unit to a safe storage state occurred in 2014. The 2015 station collective dose is only attributed to safe storage transition activities. Internal dose was approximately 41 percent of the total station collective dose. While this is an increase from 2014 (when the internal dose was 35 percent). The magnitude of the internal dose is largely attributable to it being a relative fraction of the very small total collective dose.

The internal collective dose in 2015 was 0.003 person. Sv. The external dose was 0.004 person Sv. The total site collective dose in 2015 was 0.007 person Sv.

4) Major 2015 Highlights

- *Regulatory Update*

  The implementation of radiation protection programs at Canadian Nuclear Power Plants (NPPs) met all applicable regulatory requirements and doses to workers and members of the public were maintained below regulatory dose limits.

- *Safety-related issues*

  No safety-related issues were identified in 2015.

- *Decommissioning Issues*

  Gentilly-2 continued to transition to safe storage in 2015.

- *New Plants under construction/plants shutdown*

  No Units under construction in 2015.
  No Units were shut down in 2015.

5) Conclusions

The 2015 average collective dose per operating unit for the Canadian fleet was 0.83 person-Sv/unit, nearly achieving the CANDU WANO dose target of 0.80 person-Sv/unit. The refurbishment activities executed in 3 of the 19 operational from 2010-2012 are showing solid benefits by providing improved unit reliability/nuclear safety and dose reduction at Bruce A, Units 1,2 and Pt. Lepreau.

The collective dose for all operating Canadian plant 2011-2015 was 15.84 person mSv. The collective dose from routine operations was 2.10 person mSv and the collective dose from outages was approximately 13.74 person mSv. Outages accounted for approximately 15% of the total collective dose. Internal dose contributed approximately 15% of the total collective dose with tritium the main dose contributor.

The implementation of initiatives to keep doses ALARA including improved shielding, source term reduction activities, use of CZT 3D isotopic mapping systems and improved work planning continue to reduce the collective dose per unit.

CHINA

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	23	395
VVER	2	260
PHWR	2	402
All types	27	385

2) Principal events of the year 2015

- *Events influencing dosimetric trends*

  In 2015, there were no radiological events threatening the safety of people and the environment at the operational nuclear power plants. The monitoring index over the year showed that the integrity of three safety barriers was in sound status.

  - For the operational nuclear power plants, the dose information in the table above is summarized for the 27 reactors operating before the end of 2015. In those reactors, refuelling outages were performed for 15 of 23 PWR units, 1 of 2 PHWR units, and 2 of 2 VVER units in 2015.
  - Eight new PWR units (Fangjiashan 1-2, Hongyanhe 3, Ningde 3, Fuqing 1-2 and Yangjiang 1-2) began to operate in 2015.

- *New/experimental dose-reduction programmes*

  In the operation of nuclear power plants, annual collective dose is mainly from outages. The ALARA programme is well implemented during the design and operation of all nuclear power plants. The average annual collective dose per unit varied slightly in comparison with the year 2014, and stayed at a low level.

- *Regulatory requirements*

  - In 2015, the Environmental and Resource Protection Committee of the National People's Congress completed the draft Nuclear Safety Act of the People's Republic of China by the study and development of related specific subjects.
  - In 2015, all operational nuclear power plants completed improvement actions according to "General technical requirments of improvement actions for nuclear power plants after the Fukushima accident" issued in 2012.
  - In 2015, the "Thirteenth five-year plan and 2025 perspective plan on nuclear safety and prevention & Control of Radioactive pollution" (Draft) was issued.

3) Report from Authority

NNSA Annual Report in 2015 (Chinese) has been drafted and will be published soon.

CZECH REPUBLIC

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
VVER	6	140

2) Principal events of the year 2015

- *Events influencing dosimetric trends*

  The main contributions to the collective dose were 5 planned outages.

NPP, Unit	Outage information	CED [man.mSv]
Temelin, Unit 1	64 days, standard maintenance outage with refuelling	46
Temelin, Unit 2	104 days, standard maintenance outage with refuelling	114
Dukovany, Unit 1	124 days, prolonged maintenance outage with refuelling, weld radiography and LTO (long-term operation) process	352
Dukovany, Unit 2	34 days, standard maintenance outage with refuelling	55
Dukovany, Unit 3	19 days, standard maintenance outage with refuelling	70

  CED increased in 2015 in comparison with the previous year mainly due to the LTO process and radiography of Primary and Secondary pipe welds during the outage of Unit 1 at Dukovany NPP.

  There was one radiation event at Temelin 2 in the year 2015 – Primary-to-Secondary Steam Generator leakage. This event had no impact on the general public. Reconstruction of a leaky pipe in a SG and subsequent repairs caused an increase of CED at Temelin 2.

  Very low values of outage and total effective doses represent results of a good primary chemistry water regime, well organised radiation protection structure and strict implementation of ALARA principles during the activities related to the work with high radiation risk. All CED values are based on electronic personal dosimeter readings.

- *New/experimental dose-reduction programmes*

  There were no new/experimental dose reduction programmes.

- *Organisational evolutions*

  In 2015 activities continued for two working groups (WG) established by the RP department in 2013:

  - Personal Contamination Events reduction WG, which aims for overall improvement of personnel perception of PCEs and ultimate reduction of the number of PCEs; and
  - Radiation Work Permit WG which is focused on the revision of the RWP system, classification of RCA areas and EPD alarm settings.

- *Regulatory requirements*

  The Post-Fukushima National Action Plan is being implemented progressively at Temelin NPP and Dukovany NPP.

  The LTO process was under way at Dukovany 1. Regulatory requirements are being implemented progressively.

3) Report from Authority

The State Office for Nuclear Safety (SUJB) carried out 48 inspections of radiation protection at nuclear facilities and contractors in 2015. Serious shortcomings were not identified.

At the end of the year, SUJB issued the license for operation of the workplace where radiation activities are performed, comprising the four units of Dukovany NPP and the Spent fuel storage facility Dukovany, for the next ten years.

Work on the “new” Atomic Act has been completed and preparation of implementing regulations was on-going. Requirements of the new Euratom BSS directive have been implemented.

FINLAND

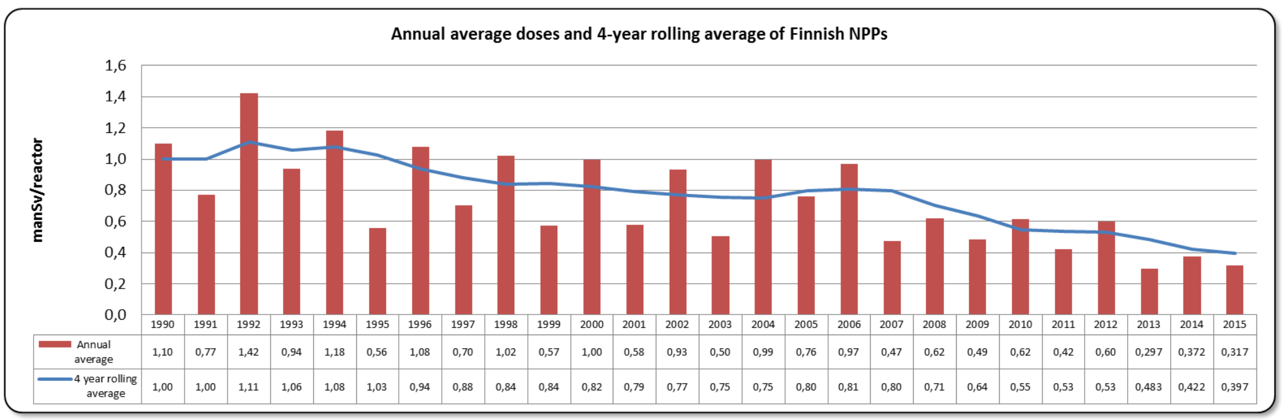
1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
VVER	2	258.43
BWR	2	376.24
All types	4	317.34

2) Principal events of the year 2015

Summary of national dosimetric trends

The annual collective dose strongly depends on the length and type of annual outages. The 2015 collective dose (1.269 man·Sv) of Finnish NPPs was the second lowest in the operating history, mainly due to short refuelling outages at three of four reactors. In the long run the 4-year-rolling average of collective doses shows a decreasing trend since the early 1990's.



Olkiluoto

The annual outage of 2015 at Olkiluoto Unit 2 was a maintenance outage. The duration of the outage was about 17 days. In addition to refuelling, some maintenance activities were carried out, including the replacement of low-voltage switchgear in two subsystems, mixing point change for the feed-water system and reactor cooling system and several other modification and maintenance jobs. Apart from TVO's own personnel, just over 800 subcontractor employees were involved in the OL2 outage. The collective outage dose was 0.438 man·Sv.

The refuelling outage at Olkiluoto Unit 1 took about 10 days including refuelling, maintenance and repair work, and some tests. The most significant maintenance work was the mixing point change for the feed-water system and the reactor cooling system. Just over 450 subcontractor employees were involved in the OL1 outage. The collective dose of the short refuelling outage was 0.176 man·Sv.

The maximum personal outage dose was 4.7 mSv.

On both units the Risk-Informed In-Service Inspection (RI-ISI) approach has been implemented on ASME piping inspection programs. The RI-ISI program is expected to reduce dose in the future.

Loviisa

On both units the 2015 outages were short refuelling outages, with durations of some 21 and 17 days. The outage collective doses were among the lowest in plant operating history: 0.238 and 0.223 man·Sv respectively. Main contributors to collective dose accumulation were reactor related tasks (disassembly, assembly), cleaning/decontamination and auxiliary work such as radiation protection, insulation and scaffolding. On both units new level measurement piping was installed to the steam generators as part of plant instrumentation renewal.

Source term reduction: After 5 years of studies, testing and approval, one antimony-free mechanical seal was installed in one of Loviisa 1's six primary coolant pumps in 2012. During the 2013 outage, this seal was inspected and approved. Following that approval, all seals on both units were replaced during outages in 2013 and 2014. The seal replacement project has resulted in a decrease of radioactive antimony and thus reduced dose rates in the vicinity of primary components.

3) Report from Authority

On November 12th, 2015, the Finnish Government granted a construction license for the Olkiluoto Spent Nuclear Fuel encapsulation and disposal facility. STUK gave its safety assessment on the construction license application in February 2015.

The Nuclear Energy Act was revised to broaden STUK’s legal mandate to issue binding regulations and licence conditions. This is one of the recommendations from the IRRS mission to Finland in 2012. The IRRS follow-up was carried out in June 2015. STUK will publish the new binding regulations concerning nuclear safety, security, emergency preparedness and waste management in the beginning of 2016.

The implementation of the new regulatory guides (YVL Guides) was carried out for the operating NPPs during 2015. For Olkiluoto Unit 3, the implementation decisions will be made in conjunction with the operating license application review.

One new unit entered into the construction license phase at the end of June 2015 (the Fennovoima Hanhikivi Unit 1).

In other sectors of the nuclear cycle, a research reactor will be decommissioned.

FRANCE

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	58	710
REACTORS DEFINITIVELY SHUTDOWN OR IN DECOMMISSIONING		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	1	88.8
GCR	6	23.3
GCHWR	1	11.4
SFR	1	3.4

2) Principal events of the year 2015

For 2015, the average collective dose of the French nuclear fleet (58 PWR) is 0.71 man·Sv/unit (as compared to the 2015 annual EDF objective of 0.79 man·Sv/unit). The average collective dose for the 900 MWe 3-loop reactors (900 MWe – 34 reactors) is 0.86 man·Sv/unit and the average collective dose for the 4-loop reactors (1300 MWe and 1450 MWe – 24 reactors) is 0.50 man·Sv/unit.

Type and number of outages

Type	Number
ASR – short outage	22
VP – standard outage	21
VD – ten-year outage	4
No outage	10
Forced outage	1

Specific activities

Type	Number
SGR	1 – not finished in 2015 (Paluel 2)
RVHR	0

The outage collective dose represents 81% of the total collective dose. The collective dose received when the reactor is operating represents 19% of the total collective dose. The collective dose due to neutron is 0.247 man·Sv; 78% of which (0.192 man·Sv) is due to spent fuel transport.

Individual doses

In 2015, no worker received an individual dose higher than 16 mSv in 12 rolling months on the EDF fleet. 76% of the exposed workers received a cumulative dose lower than 1 mSv, and 99.5% of the exposed workers received less than 10 mSv.

3) Principal events of the year 2015

The main 2015 events with a dosimetric impact are the following:

- Blayais 3 SGR:
  The SGR (steam generator replacement) of unit 3 set a new record for the lowest dose received for a SGR, with 455 man·mSv. This was a long outage as it lasted from April 25th, 2014 to September 5th, 2015.
- Seismic resistance following a global safety event on the fleet:
  Biologic shielding whose seismic resistance was not proved has been removed. These removals impact the radiological conditions of areas in the nuclear auxiliary building and also for field and radiological protection inspections.
- Decontamination:
  For 4-loop reactors (1,300 MWe), decontamination and cleaning of Solid Waste Treatment System tank and Liquid Waste Treatment system evaporator before inspections.
- Radiography inspection with Selenium:
  Paluel, Flamanville, Cattenom and Nogent have been using Selenium-75 for radiographic inspections. These first experimentations allowed radiographic inspection to occur concurrent with (at the same time as) other activities in the turbine building, so time savings were achieved for the outage schedule.

3-loop reactors – 900 MWe

In 2015, Bugey 2, Fessenheim 1 and Gravelines 6 had no outage. Fessenheim 1 had a forced outage for 4 days for an occupational exposure of 5 man·mSv.

The 3-loop reactors outage program was composed of 14 short outages, 13 standard outages, and 3 ten-year outages. One Steam Generator Replacement was performed on Blayais 3.
Two outages of the 2014 program ended in 2015: the third ten-year outage and steam generator replacement at Blayais 3 for 0.391 man·Sv and a short outage at Cruas 2 (collective dose in 2015: 0 man·Sv for 5 days).
One outage of 2015 was not finished at the end of the year: Bugey 5 (end of the standard outage for a planned occupational exposure of 0.133 man·Sv).

The lowest collective doses for the various outage types and specific activities were:

- Short outage: 0.123 man·Sv at Chinon B4
- Standard outage: 0.609 man·Sv at Chinon B3
- Ten-year outage: 1.696 man·Sv at Cruas 1
- SGR: 0.455 man·Sv at Blayais 3.

4-loop reactors – 1,300 MWe and 1,450 MWe

In 2015, 8 units had no outage. There were 2 forced outages: Cattenom 4 (11 man·mSv) and Nogent 2 (42 man·mSv).

The 4-loop reactors outage program was composed of 8 short outages, 8 standard outages and 1 ten-year outage.

The lowest collective doses for the various outage types were:

- Short outage: 0.149 man·Sv at Cattenom 3
- Standard outage: 0.493 man·Sv at Nogent 2.

Main radiation protection significant events (ESR)

In 2015, 3 events were classified at the INES scale.

- Gravelines NPP (rated level 1 at the INES scale)
  1 ESR on Unit 5: skin dose higher than one quarter of the annual limit when checking padlocking on reactor cavity and spent fuel pit cooling and treatment system.
- Nogent NPP (rated level 1 at the INES scale)
  1 ESR on Unit 1: skin dose higher than one quarter of the annual limit on waste treatment.
- Blayais NPP (rated level 2 at the INES scale)
  1 ESR on Unit 4: skin dose higher than the annual limit.
  Contamination on the chin by a particle of Co-60 of activity estimated at 504 kBq during the preparation of the requalification of the CVCS regenerative heat exchanger.

2016 goals

For 2016, the collective dose objective for the French nuclear fleet is set at 0.80 man·Sv/unit.

For the individual dose, one of the objectives is to reduce by 10% in 3 years, the individual dose of the most exposed workers. The other objectives are the following:

- Less than 5 workers with a dose > 14 mSv;
- Less than 300 workers with a dose > 10 mSv.

Future activities in 2016

Collective dose: continuation of the activities initiated since 2012.

- Implementation of the action plan on radiography inspection;
- Source Term management (oxygenation and purification during shutdown, management and removal of hotspots);
- Chemical decontamination of the most contaminated circuits;
- Optimization of biologic shielding (using CADOR software);
- Organizational preparation of the RMS, deployment of the fleet planned from 2016 to 2018.

49 outages are planned for 2016 with 22 short outages, 22 standard outages and 5 ten-year outages, including a ten-year outage on 3-loop reactor combined with a SGR and the end of the one started at Paluel 2 in 2015 (lead unit). For 2016 hydrotests on RHRS circuits are expected: Blayais, Cruas, Dampierre, Tricastin, Gravelines, Cattenom, Penly and Paluel, and supplementary controls and activities (due to post-Fukushima, “Grand carénage” and ASN demands).

3) Report from Authority

In 2015, ASN carried out 28 radiation protection inspections. In 2015, ASN focused particular attention on compliance with the prescriptions for occupational radiation protection during work in controlled zones and this was checked in most of the NPPs operated by EDF.

The collective dose on all the reactors fell slightly in 2015 by comparison with 2014. The average dose received by the workers for one hour of work in a controlled zone has been falling since 2013.

ASN considers that the radiation protection situation of the NPPs in 2015 could be improved on a certain number of points:

- The management of industrial radiography worksites could be improved. ASN in particular observed two events in which the signs barring entry to operations areas were ignored. Progress is expected in the preparation of the worksites, more specifically the involvement of all stakeholders and the quality of the installation visits carried out when preparing these worksites.
- Management of contamination dispersal inside the reactor building is still insufficient, owing to inadequate worksite containment or contamination level signage errors. ASN repeatedly observed non-compliance with instructions for contamination checks on personnel exiting worksites, the lack of contamination inspection devices or devices that are unserviceable. In addition, on several sites, the inspectors found a lack of radiation protection culture on the part of certain workers.

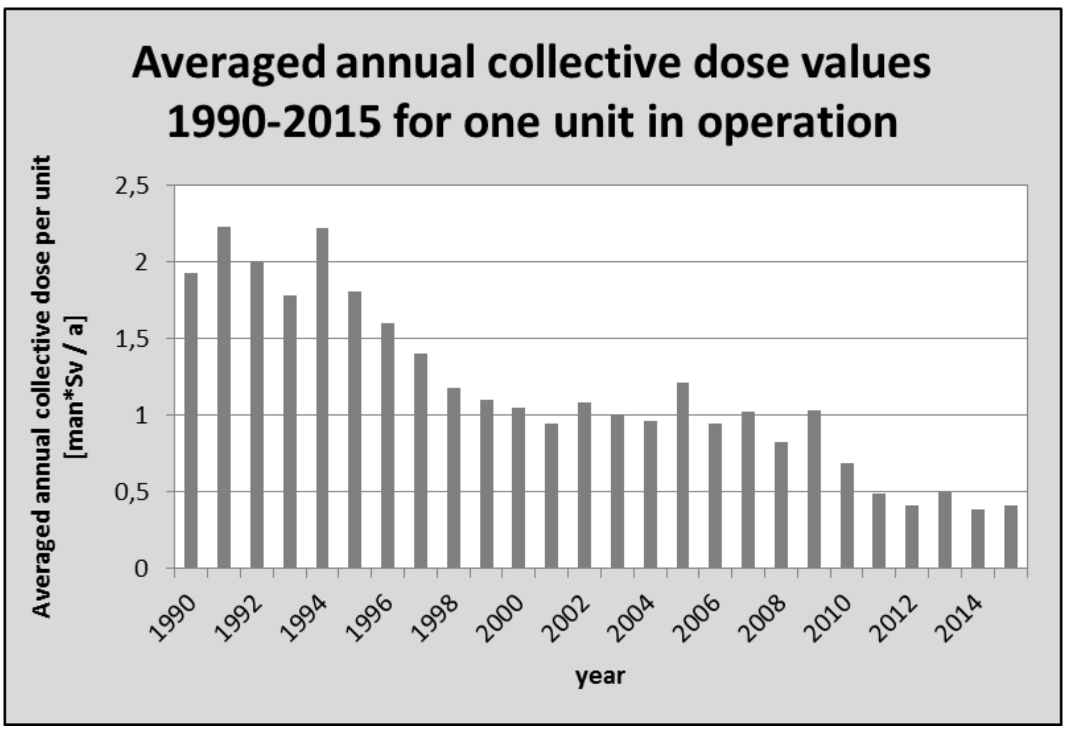
These inadequacies can contribute to delaying the detection of bodily contamination of the workers:

- With regard to exposure monitoring, ASN has observed numerous events relating to the failure of workers to wear individual dosimeters. Improvements were however observed in terms of the optimisation of exposed worker classification and improvements in remote-dosimetry.
- EDF has taken steps to reinforce control of personnel access to limited stay areas, although further improvements are still required. ASN observes inadequacies in the identification and signposting of these areas.

GERMANY

1) Dose information for the year 2015

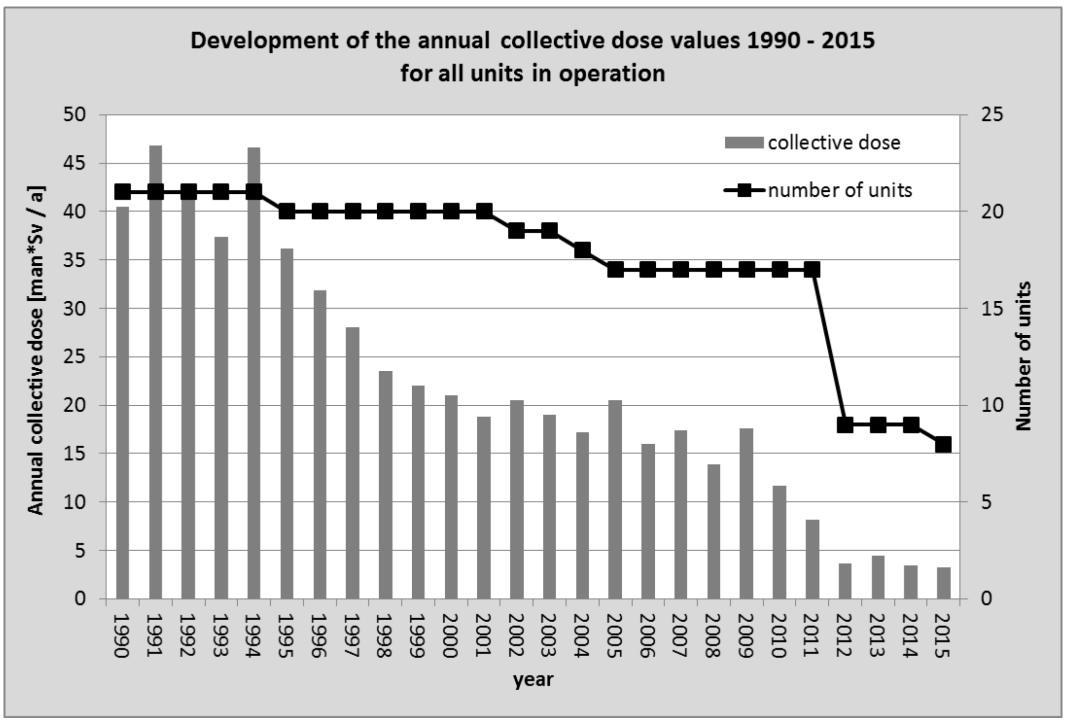
ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	6	169
BWR	2	1,114
All types	8	360
REACTORS DEFINITIVELY SHUTDOWN OR IN DECOMMISSIONING		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	7	84
BWR	4	91
All types	11	86



Summary of national dosimetric trends

Due to the political decisions after the Fukushima accident in 2011, eight nuclear power plants (Unterweser, Biblis A, Biblis B, Neckarwestheim 1, Philippsburg 1, Krümmel, Brunsbüttel and Isar 1) were permanently shut down in the middle of the year 2011. The nuclear power plant Grafenrheinfeld was shut down on June 27th, 2015. The remaining eight nuclear power plants will be finally shut down in a stepwise process until 2022, due to the amendment of the Atomic Energy Act of July 2011; one plant each by the end of 2017 and 2019 and another three at the end of 2021 and of 2022.

In 2015, the average annual collective dose per unit in operation was 0.40 man·Sv which is comparable to the value of 0.38 man·Sv in the year 2014. The trend in the average annual collective dose from 1990 to 2015 is presented in the figure above. For the plants in decommissioning, the value of the average annual collective dose is even lower, at 0.09 man·Sv.



HUNGARY

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
VVER	4	441 (with electronic dosimeters) 436 (with TLDs)

2) Principal events of the year 2015

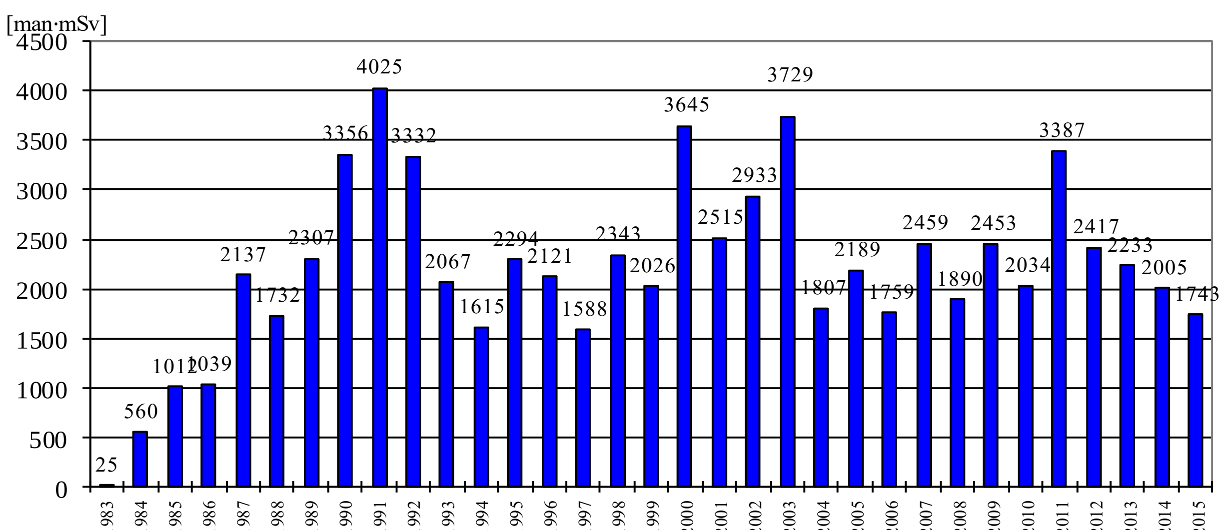
Summary of national dosimetric trends

Using the results of operational dosimetry the collective radiation exposure was 1,765 man·mSv for 2015 at Paks NPP (1,330 man·mSv with dosimetry work permit and 435 man·mSv without dosimetry work permit). The highest individual radiation exposure was 9.2 mSv, which was well below the dose limit of 50 mSv/year, and our dose constraint of 20 mSv/year.

The collective dose decreased in comparison to the previous year. The lower collective exposures were mainly ascribed to the exposure-reduction investment activities which resulted in higher doses ending in 2014.

The electronic dosimetry data correspond well with TLD data in 2015.

Development of the annual collective dose values at Paks Nuclear Power Plant (upon the results of the TLD monitoring by the authorities):



From 2000, this data shall be quoted as individual dose equivalent /Hp(10)/

- *Events influencing dosimetric trends*

  There was one general overhaul (long maintenance outage) in 2015. The collective dose of the outage was 639 man mSv at Unit 1.

- *Number and duration of outages*

  The durations of outages were 65 days at Unit 1, 26 days at Unit 2, 29 days at Unit 3, and 24 days at Unit 4.

ITALY

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
REACTORS DEFINITIVELY SHUTDOWN OR IN DECOMMISSIONING		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	1	17.82 (1 unit - Trino NPP)
BWR	2	80.04 (1 unit Caorso NPP [2.96 man·mSv] + 1 unit Garigliano NPP [77.08 man·mSv])
GCR	1	61.02 (1 unit - Latina NPP)

JAPAN

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit·year]**
PWR	24	188
BWR	24	223
All types	48	205
REACTORS DEFINITIVELY SHUTDOWN OR IN DECOMMISSIONING		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit·year]**
BWR	8	9.724
GCR	1	0
LWCHWR	1	46

2) Principal events of the year 2015

- *Outline of national dosimetric trend*

  The average annual collective dose for shutdown BWRs decreased from 13.081 man·mSv/unit in the previous year (2014) to 9.724 man·mSv/unit in 2015. The average annual collective dose excluding Fukushima-daiichi NPP for this year was 44 man·mSv/unit, and that of Fukushima-daiichi NPP was 12.943 man·mSv/unit.

  The average annual collective dose of operating reactors was almost at the same level as for 2014. This is because almost all of the nuclear reactors have been shut down for a long time after the accident at Fukushima-daiichi NPP.

- *Operating status of nuclear power plants*

In FY 2015, only three PWRs operated.

From April 1st to August 13th, 2015	: no unit operated
From August 14th to October 20th, 2015	: 1 unit (Sendai unit 1)
From October 21st, 2015 to January 31st, 2016	: 2 units (Sendai unit 1, 2)
From February 1st to March 9th, 2016	: 3 units (Sendai unit 1, 2, Takahama 3)
From March 10th to March 31st, 2016	: 2 units (Sendai unit 1, 2)

- *Exposure dose distribution of workers in Fukushima-daiichi NPP*

  Exposure dose distributions at Fukushima-daiichi NPP for cumulative dose until March 2016 and for dose during FY 2015 are shown below.

As of July 31,2016

Cumulative dose Classification (mSv)	Number of workers (March 2011 – March 2016)			Fiscal year 2015 (April 2015 – March 2016)		
	TEPCO	Contractor	Total	TEPCO	Contractor	Total
＞250	6	0	6	0	0	0
200 ～ 250	1	2	3	0	0	0
150 ～ 200	26	2	28	0	0	0
100 ～ 150	117	20	137	0	0	0
75 ～ 100	321	312	633	0	0	0
50 ～ 75	328	1801	2129	0	0	0
20 ～ 50	633	6515	7148	6	592	598
10 ～ 20	619	5794	6413	52	1947	1999
5 ～ 10	507	5439	5946	108	2247	2355
1 ～ 5	908	9618	10526	533	5114	5647
≦1	1246	12759	14005	998	6599	7597
Total	4712	42262	46974	1697	16499	18196
Max. (mSv)	678.80	238.42	678.80	24.00	43.20	43.20
Ave. (mSv)	22.43	11.76	12.83	1.85	4.52	4.27

* TEPCO uses the integrated value from the APD that is employed every time an individual enters the radiation controlled area of the facility. These data are sometimes replaced by monthly dose data measured by an integral dosimeter for the individual.
* There has been no significant internal radiation exposure reported since October 2011.
* Internal exposure doses may be revised when the reconfirmation is made.

- *Regulatory requirements*

  The examination of the new safety standards began in July 2013. Three PWRs obtained approval in FY 2015.

3) Report from Authority

The IAEA conducted an Integrated Regulatory Review Service (IRRS) mission to NRA from January 11th to 22nd, 2016.

The mission report was sent from IAEA and received by NRA on 23 April 2016.

Good practices

• The Government of Japan has put in place a framework which established and supports NRA as a new effective independent and transparent regulatory body with increased powers.

• NRA made a prompt and effective incorporation of the lessons learnt from the TEPCO Fukushima-daiichi accident in the areas of natural hazards, severe accident management, emergency preparedness and backfitting of existing facilities, into the Japanese legal framework.

Recommendations and Suggestions concerning Radiation Protection

• The government should ensure that the Japanese regulatory authorities having responsibilities relevant to nuclear and radiation safety develop and implement an effective, collaborative process for the exchange of information regarding policies, authorisations, inspections and enforcement actions to provide coordinated and effective regulatory oversight that should also ensure a harmonized regulatory framework under their respective responsibilities.

• The Government should empower the regulatory body to establish requirements for authorization or approval processes for service providers for monitoring of occupational and public exposures, and environmental monitoring in general, and verify that these requirements are met by licensees.

• NRA should put greater priority and allocate more resources on its oversight of the implementation of radiation protection measures by licensees as well as its participation in the development of international standards in radiation protection and related research activities in collaboration with NIRS.

• NRA should establish requirements relating to consideration of decommissioning during all life stages of nuclear and radiation facilities and criteria for the release of sites at the end of decommissioning.

• NRA and other authorities having jurisdiction for radiation sources should develop a single set of requirements and guidance for EPR in relation to radiation sources including requirements related to emergency plans, arrangements for timely notification and response, and quality assurance programme using graded approach.

• NRA should consider strengthening its plans and procedures to consistently respond to emergencies related to radiation sources.

Response to issues concerning Radiation Protection in FY 2016

• NRA will create a proposal for detailed system design of regulatory requirements to licensees of radioisotopes which include development of an emergency response system, theft prevention measures (security), safety culture and quality assurance, etc.

• Based on the above proposal, NRA will revise the regulations.

• To strengthen the inspection system for radioisotopes, NRA considers the improvement of training programmes for inspectors with sufficient capacity for the new field of inspection and requirements for an increase in manpower.

• NRA considers establishment of a mechanism to identify, collect, and evaluate up-to-date knowledge of radiation protection.

• Based on domestic and international trends, NRA considers a framework for improvement of quality assurance in the monitoring of occupational exposure, etc.

KOREA, REPUBLIC OF

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	21	310.52
PHWR	4	585.15
All types	25	354.46

2) Principal events of the year 2015

- *Summary of national dosimetric trends*

For the year 2015, 25 NPPs were in operation; 21 PWR units (Shin Kori #3 is under commissioning) and 4 PHWR units. The average collective dose per unit in 2015 was 354.46 man·mSv. The dominant contributors of the collective dose in 2015 were the works carried out during the outages, resulting in 86.6 % of the total collective dose. 14,926 people were engaged in radiation works and the total collective dose was 8,861.58 man·mSv.

- *Number and duration of outages*

Overhauls were performed at 16 PWRs and 3 PHWRs. The total duration for the outages was 1,074 days for PWRs and 277 days for PHWRs. Total outage duration was increased by compared to that in 2014.

- *Component replacements*

  - Reactor Vessel Head was replaced at Hanbit 4 from August 2015 to November 2015 during the outage, resulting in 40.05 man·mSv.
  - Steam generator tubes were maintained at Hanul 4 in 2015, resulting in 78.57 man·mSv.

- *Unexpected events/incidents*

None

- *New reactors on line in 2015*

  - Shin Wolsong Unit 2 starts commercial Operation (2015/7/24).
  - Shin Kori #3 is under commissioning. (Reactor Fuels are loaded.)

- *New dose-reduction programmes*

  A trial application of zinc injection to reduce source term has been applied to Hanul 1 from 2010, and as a result of this attempt, there was about 30% ~ 40% decrease of radiation exposure rate at RCS pipings and steam generator chambers. KHNP is planning to extend zinc injection to other reactors. Zinc injection is scheduled to be applied to 4 NPPs (Hanbit 3, 4/ Hanul 3,4) from 2017, and 4 NPPs (Kori 2, Hanul 2, Hanbit 5, 6) from 2018.

LITHUANIA

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
REACTORS DEFINITIVELY SHUTDOWN OR IN DECOMMISSIONING		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
LWGR	2	342.09

2) Principal events of the year 2015

- *Events influencing dosimetric trends*

  In 2015, the occupational doses at the Ignalina NPP (INPP) were maintained as low as possible, taking into account all economic, social and technological conditions: 631 man·mSv in 2011, 587 man·mSv in 2012, 655 man·mSv in 2013, 638 man·mSv in 2014, and 684 man·mSv (62% of planned dose) in 2015. The collective dose for INPP personnel was 619.9 man·mSv (65% of planned dose), and for contractor personnel – 64.3 man·mSv (40% of planned dose). The external dosimetry system used was Thermoluminescence dosimeters (TLD).

  The 20 mSv individual dose limit was not exceeded. The highest individual effective dose for INPP staff was 9.37 mSv, and for contractor personnel – 7.13 mSv. The average effective individual dose for INPP staff was 0.36 mSv, and for contractor personnel – 0.06 mSv.

  The main works that contributed to the collective dose during technical service and decommissioning of Units 1 and 2 at the INPP were fuel handling; repairing of the hot cell; modernization and maintenance works at the spent fuel storage pool hall, reactor hall and reactor auxiliary buildings; waste and liquid waste handling; radiological monitoring of workplaces and radiological investigations; and isolation of the main circulation circuit.

  In 2015, no component or system replacements were performed. In 2015, there were no unexpected events.

- *New/experimental dose-reduction programmes*

  The doses were reduced by employing up-to-date principles of organization of work, by doing extensive work on modernization of plant equipment, and by using automated systems and continuously implementing programs of introducing ALARA principle during work activities. The evaluation and upgrading of the level of safety culture, extension and support to the effectiveness of the quality improvement system are very important.

- *Organisational evolutions*

  Year 2015 was very important to decommissioning of INPP. During the year, significant progress was made in implementation of the major decommissioning projects. Results of great importance to the safe decommissioning of INPP were achieved.

Cold trials of the new Spent Nuclear Fuel Storage Facility were successfully completed and functionality of the building, installed systems and equipment was demonstrated. An issue on safety justification of spent nuclear fuel casks was resolved. Cold trials of the Solid Radioactive Waste Handling and Storage Facility were started.

At the end of 2015, the State Nuclear Power Safety Inspectorate issued a license for construction and operation of a Landfill Facility for Short-lived Very Low Level Waste.

The progress of key decommissioning projects was evaluated by the contributing countries and European Commission as positive. The progress of decommissioning projects was presented to the delegations of the embassies of Denmark, Canada, Germany, France, Spain, the Netherlands and Japan.

In 2015, the dismantling works continued, with about 8.6 thousand tonnes of equipment dismantled that year.

The second stage of the enterprise structural change was completed at the end of the year. The dismantling planning and control functions were separated from the dismantling implementation process.

The positive practice of cooperation with IAEA was maintained in 2015. An International Workshop on Development of Specific Decontamination Techniques for RBMK Reactors Dismantling and Removal of Radioactive Material was organized at the INPP, where the experts of different countries shared their experience.

The priority activities of INPP are nuclear and radiation safety, transparency and effectiveness of the activity, responsibility of staff and high professional quality of workers, and social responsibility.

3) Report from Authority

In 2015, VATESI carried out radiation protection inspections at Ignalina NPP in accordance with an approved inspection plan. Assessments were made regarding how radiation protection requirements were fulfilled in the following areas and activities: clearance of radioactive materials, monitoring of occupational exposure and radiation protection during dismantling and decontamination works of turbine hall equipment of Unit 1. Inspections results showed that Ignalina NPP activities were carried out in accordance with the established radiation protection requirements.

In 2016, VATESI will continue supervision and control of nuclear safety of decommissioning of INPP, management of radioactive waste, including the construction and operation of new nuclear facilities, as well as the radiation protection of these activities and facilities. To enhance the level of radiation protection during decommissioning of the INPP, VATESI will continue to review radiation protection requirements established in legal documents. It is planned to approve amended requirements on occupational radiation protection at nuclear facilities by the end of 2016.

MEXICO

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
BWR	2	4833,51

2) Principal events of the year 2015

Summary of national dosimetric trends

The nuclear reactors existing in Mexico are two BWR/GE units at the Laguna Verde Nuclear Power Station located in Laguna Verde, State of Veracruz, Mexico.

Laguna Verde's historical collective dose both on line and during refuelling outages is higher than the BWRs average. On line collective dose is high because of shortfalls or failures in equipment reliability. Some examples are steam leaks, reactor water cleanup system pump failures, and radwaste treatment systems failures. Refuelling outage collective dose is high mainly because the radioactive source term (Co-60) caused high radiation areas.

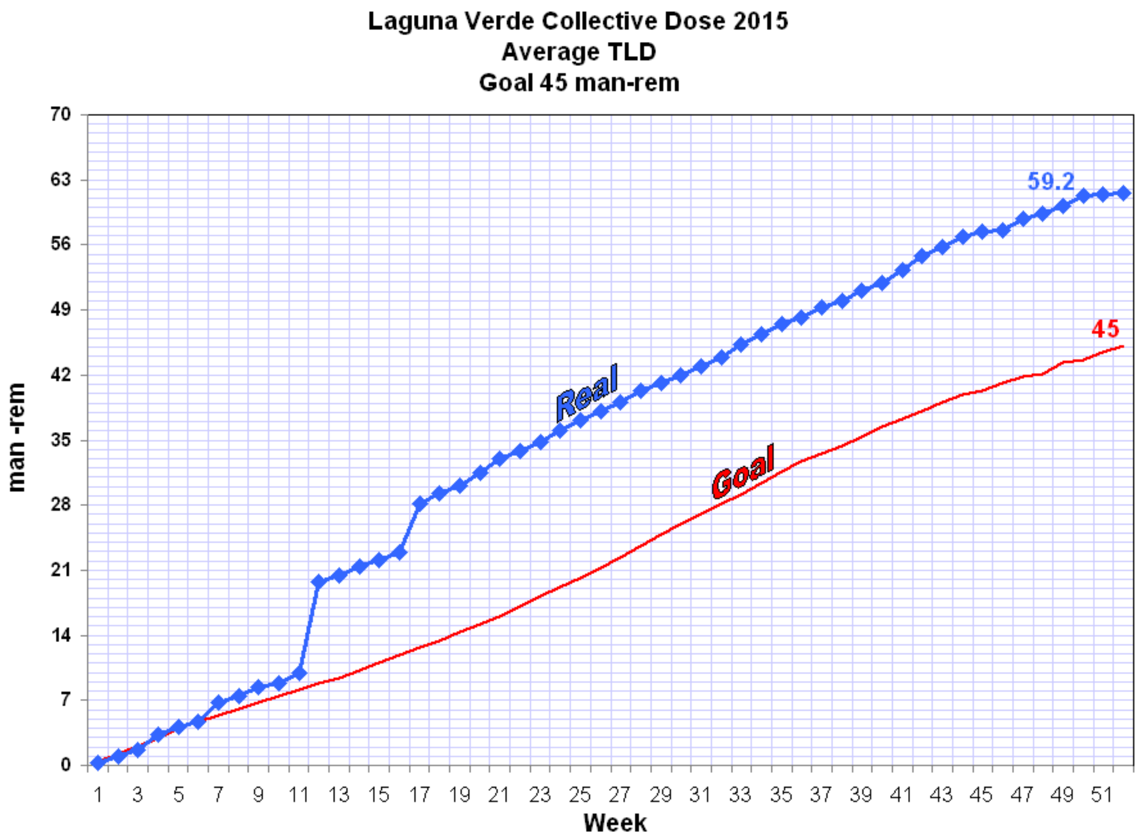
There was the LV's Vice President's strong commitment to keep collective dose ALARA.

2015 collective dose was the lowest for on line (normal) operation. For unit 1 it was 0.59175 man·Sv and unit 2, 0.5585 man·Sv; no matter , Laguna Verde staff recognizes these values are high when compared with those of other BWRs.

- *Events influencing dosimetric trends*

  a) Increase of radioactive source term: this factor was originated by the reactor water chemical instability induced in turn by the application of noble metals and hydrogen since 2006 to prevent the stress corrosion cracking of reactor internals. This factor is still strongly influencing dose rates at the plant and specifically in the drywell during refuelling outages.

     Since 2011, LV's Chemistry Manager has taken the responsibility for hydrogen injection, iron control in feed water and any other condition that can result in a chemical instability inside the reactor vessel. Laguna Verde's VP has appointed a Source Term Control and Reduction Project Manager (STPM), supported by the Radiological Protection Manager (RPM) and the Chemistry Manager (CM).



On Line 2015 Collective Dose Graph

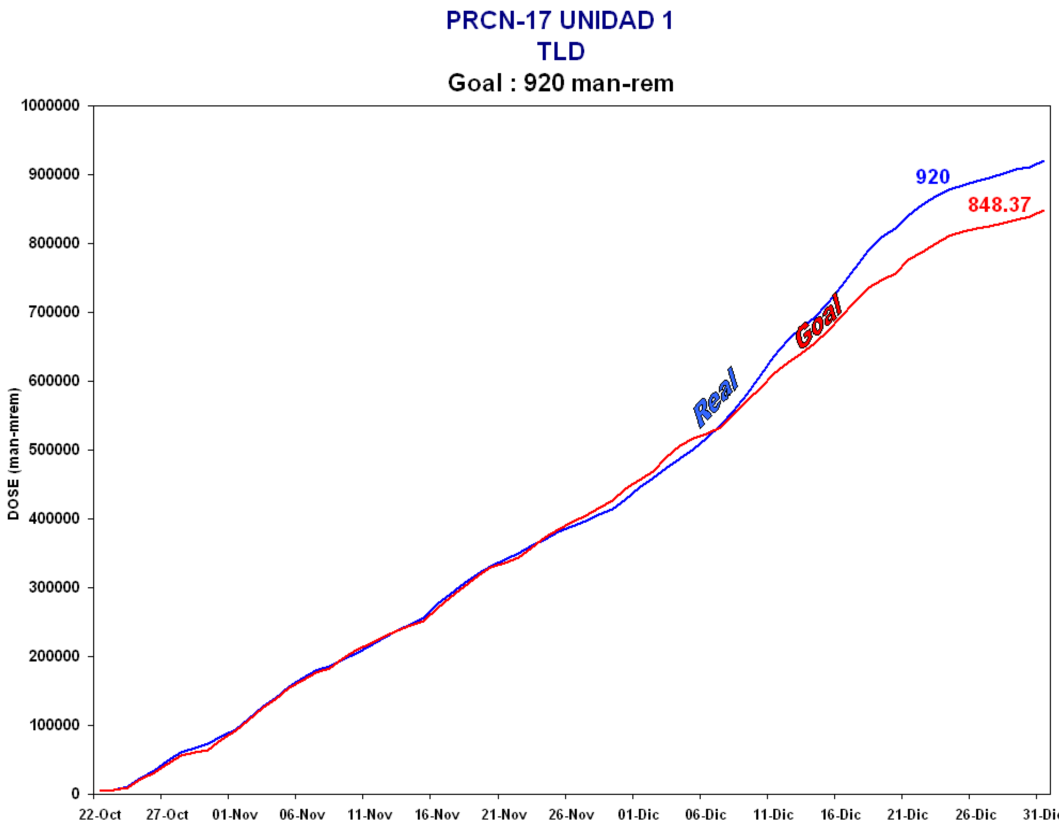
45 man-rem = 450 man-mSv

- *Number and duration of outages*

2015: 17 RFO U1 (from October 22nd 2015 to December 31th 2015) Collective dose 8.4837 man·Sv.

Forced outages:
U1:
From June 29th 2015 to July 01th 2015 in Unit 1, collective dose 0.00524 man·Sv.

U2:
From May 19th 2015 to May 24th 2015 in Unit 2, collective dose 0.01441 man·Sv.
From May 12th 2015 to May 15th 2015 in Unit 2, collective dose 0.01519 man·Sv.



- *New plants on line / plants shutdown*

  None

- *Major evolutions*

  None

- *Component or system replacements*

  None

- *Safety-related issues*

  None

- *Unexpected events*

  None

- *New/experimental dose-reduction programmes*

  The main problem associated with the high collective dose at Laguna Verde NPS is the continued increase of the radioactive source term (insoluble Cobalt deposited in internal surfaces of piping, valves and equipment in contact with the reactor water coolant).

Control and optimisation of reactor water chemistry plays a fundamental role in the control and eventual retraction of the source term. The main strategies / actions aiming at such purpose are:

- Chemical decontamination of recirculation loops during refuelling outages: to be applied until all of the other reactor water chemistry parameters become stabilized and optimised, in order to avoid a recontamination next cycle after the decontamination; On Line Noble Metal Chemistry (OLNC);
- Cobalt selective removal resins continuously applied to reactor water;
- Continuous application of Zinc to the reactor water;
- Control of Iron concentration in feed water;
- Reactor Water Cleanup System (RWCU) continuous operation;
- Fuel Pool Cooling and Cleanup System (FPCC) hydrolysing;
- Optimising continuity and availability of Hydrogen injection to the reactor;
- CRUD pumps with high flow (600 gpm) during the outages (2014);
- Portable demineralizer during the outages (2014);
- RWCU system modifications to improve its efficiency.

- *Organisational evolutions*

  None

For 2016

Issues of concern in 2016

Two refuelling outages - 18 RFO Unit 1 and 15 RFO Unit 2.

Technical plans for major work in 2016

Work on the above-mentioned strategies for radioactive source term reduction.

Regulatory plans for major work in 2016

No comments.

THE NETHERLANDS

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	1	Collective dose = 217.2 man·mSv; average individual = 0.29 mSv
REACTORS DEFINITIVELY SHUTDOWN OR IN DECOMMISSIONING		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
BWR	1	0

2) Principal events of the year 2015

- *Events influencing dosimetric trends*

  Outage duration was 29 days. No specific high dose jobs.

PAKISTAN

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PHWR	1	1,843.83
PWR	2	593.705
All types	3	1,010.41

2) Principal events of the year 2015

- *Events influencing dosimetric trends*
  - PHWR 12 outages, 133 days
  - PWR (Chashma -1) 3 outages, 122 days
  - PWR (Chashma -2) 3 outages, 37.67 days

- *Component or system replacements, Unexpected events/incidents, New reactors on line, Reactors definitely shutdown*

  Moderator Heat Exchangers Tube Leak (for PHWR).

ROMANIA

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
CANDU	2	194

2) Principal events in the year 2015

Summary of national dosimetric trends

Occupational exposure at Cernavoda NPP (2000-2015)			
Year	**Internal effective dose [man·mSv]**	**External effective dose [man·mSv]**	**Total effective dose [man·mSv]**
2000	110.81	355.39	466.2
2001	141.42	433.44	574.86
2002	206.43	344.04	550.48
2003	298.02	520.27	818.28
2004	398.26	258.45	656.71
2005	389.3	342.29	731.59
2006	302.27	258.79	561.06
2007	83.34	187.49	270.83
2008 (2 units)	209.3	479.34	688.6
2009 (2 units)	67.6	417.7	485.3
2010 (2 units)	210.3	577	787.3
2011 (2 units)	56	337	393
2012 (2 units)	250.8	667.1	917.9
2013 (2 units)	92.3	416.8	509.1
2014 (2 units)	160.3	432	592.3
2015 (2 units)	36.4	351.7	388.1.3

- *Events influencing dosimetric trends*

  Normal operation of the plant (U1 & U2)

  At the end of 2015:

  - there are 90 employees with annual individual doses exceeding 1 mSv; 5 with individual doses exceeding 5 mSv; none with individual dose over 10 mSv (unplanned exposure) and none with individual dose over 15 mSv;
  - the maximum individual dose for 2015 is 6.632 mSv;
  - the contribution of internal dose due to tritium intake is 9.4%.

An aggressive policy to reduce tritium exposure has been applied since 2005, including strict control of D_2O leaks, providing dryers' availability, and optimization of personnel access in R/B. Radiation Work Permits require workers to use adequate respiratory protection both in normal operation and outages. By implementing a Tritium in Air Monitoring System, the number of routine and investigation activities for tritium monitoring was reduced by 50%. As a result, collective internal dose was significantly reduced from 250.8 man·mSv in 2012 to 160.3 man·mSv in 2014, and from 92.3 man·mSv in 2013 to 36.4 man·mSv in 2015, which are the lowest collective internal doses in the CANDU fleet.

Planned Outage

A 23-day planned outage was done at Unit 2 between May 9th and June 1st, 2015. Activities with major contribution to the collective dose were as follows:

- Fuelling machine bridge components preventive maintenance;
- Feeder – yoke clearance measurements and correction;
- Inspection for tubing and supports damages in the feeder cabinets;
- Planned outage systematic inspections;
- Feeder thickness measurements, feeder clearance measurements, feeder-yoke measurements, elbow UT examination;
- Snubbers inspection, piping supports inspection.

Total collective dose at the end of the planned outage was 172.2 man mSv (154 man mSv external dose and 18.2 man mSv internal dose due to tritium intakes).

Finally this planned outage had a 44% contribution to the collective dose of 2015.

Planned Outages dose history

Year	Unit	Interval	External collective dose received man mSv	Internal collective dose (^3H intakes) received man mSv	Total collective dose received man mSv
2003	1	15.05 – 30.06	345	161	506
2004	1	28.08 – 30.09	153	179	332
2005	1	20.08 – 12.09	127	129	256
2006	1	09.09 – 04.10	103	107	210
2007	2	20 – 29.10	16	0	16
2008	1	10.05 – 03.07	187	111	298
2009	2	09.05 – 01.06	122	11	133
2010	1	08.05 – 01.06	319	95	414
2011	2	07.05 – 01.06	117.2	13	130.2
2012	1	04.05 – 11.06	396.9	177.7	574.6
2013	2	10.05 – 03.06	185.8	49.2	235

2014	1	09.05 – 06.06	229	81.4	310.4
2015	2	09.05 – 01.06	154	18.2	172.2

Unplanned outages

Unit 1 – March 27th – March 30th: Unit was orderly shut down for corrective maintenance on Liquid Zone Control circuit. (12.4 man mSv external dose).

Radiation protection-related issues

During 2014, the implementation of Radiation Monitoring System (RMS) at Cernavoda U1 was started. The system already exists in Unit 2. This project was finalized in 2015.

The purpose of this improvement was to connect the on-line radiation monitoring equipment to a computerized interface system that allows remote monitoring, limited remote control capability and maintaining an integrated short and long-term database.

RMS interface with the following systems is enabled: Fixed Gamma Area Monitoring, Fixed Contamination Monitoring, Portable Radiation Monitors, Fixed Tritium in Air Monitoring, Liquid Effluent Monitor, Gaseous Effluent Monitor and Post Accident Air Sampling and Monitoring.

The expectation is that the collective dose of the operating personnel will decrease (by avoiding entry into high radiation hazard areas) and radiation hazard control will be improved for the normal operation of the plant (where real time radiation hazard information will be available).

Issues of concern in 2015

The main concerns for 2015 were important works, with high radiological impact, performed during the Planned Outage of Unit 2.

For 2016

Issues of concern in 2016

The main concerns for 2016 are activities with high radiological impact, to be performed during the Planned Outage of Unit 1:

- Removal of magnetite deposits from the inside diameter surface of the steam generators' tubes;
- ECT inspection of Steam Generators;
- Fuelling machine bridge components preventive maintenance;
- Feeder – yoke clearance measurements and correction;
- Inspection for tubing and supports damage in the feeder cabinets;
- Planned outage systematic inspections;
- Feeder thickness measurements, feeder clearance measurements, feeder – yoke measurements, elbow UT examination;
- Snubbers inspection, piping supports inspection;
- Implementation of engineering changes.

RUSSIAN FEDERATION

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
VVER	18	559.6
REACTORS DEFINITIVELY SHUTDOWN OR IN DECOMMISSIONING		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
VVER	2	69.3

2) Principal events of the year 2015

Collective doses

In 2015, the total effective annual collective dose of utility employees and contractors at eighteen operating VVER type reactors was 10,072.5 man·mSv. This value presents a 395.3 man·mSv (3.8%) decrease from the year 2014 total collective dose of 10,467.8 man·mSv.

Comparative analysis showed a considerable difference between average annual collective doses for the groups of VVER-440 MWe and VVER-1000 MWe operating reactors. In 2015, the results were as follows:

- 1,026.8 man·mSv/unit with respect to the group of six operating VVER-440 reactors (Kola 1-4, Novovoronezh 3-4);
- 448.2 man·mSv/unit with respect to the group of eleven operating VVER-1000 reactors (Balakovo 1-4, Kalinin 1-4, Rostov 1-2, Novovoronezh 5). Rostov 3 was not considered during this estimation. This reactor was put into commercial operation on 17 September 2015, and collective dose was 8.3 man·mSv through the end of 2015.

  Average annual collective dose for two reactors at the stage of decommissioning (Novovoronezh 1 of VVER-210 MWe and Novovoronezh 2 of VVER-365 MWe) was 69.3 man·mSv/unit as compared to 44.7 man·mSv/unit in 2014.

- *Events influencing dosimetric trends*

  In 2015, average annual collective doses for the group of VVER-440 reactors increased by 44.7% as compared to 2014. The main reason is the major repair outage and the considerable increase of collective dose to 1,677.1 man·mSv/unit at Novovoronezh 4.

  Average annual collective doses for the group of VVER-1000 reactors decreased by 20.6% as compared to 2014. As the result of 18 month fuel campaigns at all Russian units with VVER-1000 reactors (except Novovoronezh 5 NPP), there was no planned outage at three reactors (Balakovo 4, Kalinin 3 and 4) in 2015. Moreover, the planned outage at Balakovo 3, begun in 2014, was finished with a duration of 15 days in 2015. Planned outages were performed at all

VVER-1000 units in 2014. Thus, the 2015 collective dose decrease was entirely determined by the decrease in the total number and duration of planned outages as compared to 2014.

Average annual collective dose for two reactors at the stage of decommissioning increased by 55.0% in 2015. The main reason is the increase of work on radioactive waste treatment.

Individual doses

In 2015, individual effective doses of utilities' employees and contractors did not exceed the control dose level of 18.0 mSv per year at any VVER-440 or VVER-1000 reactor.

The maximum recorded individual dose was 16.8 mSv. This dose was gradually received over the full year by a worker in the Novovoronezh NPP maintenance department during the repair of reactor component equipment at Units 3-5.

The maximum annual effective individual doses at other nuclear plants with VVER type reactors in 2015 were:

- Balakovo – 14.0 mSv;
- Kalinin – 11.3 mSv;
- Kola – 14.9 mSv;
- Rostov – 6.7 mSv.

Planned outage durations and collective doses

Reactor	Duration [days]	Collective dose [man·mSv]
Balakovo 1	54	1,256.0
Balakovo 2	80	567.7
Balakovo 3	15 (completion of outage which was started in 2014)	84.6
Balakovo 4	No outage	--
Kalinin 1	33	584.7
Kalinin 2	34	474.7
Kalinin 3	No outage	--
Kalinin 4	No outage	--
Kola 1	50	483.4
Kola 2	49	300.8
Kola 3	57	1,138.9
Kola 4	49	619.3
Novovoronezh 3	31	730.7
Novovoronezh 4	70	1,523.0
Novovoronezh 5	67	940.4
Rostov 1	63	193.7
Rostov 2	45	157.0
Rostov 3	No outage	--

Unplanned outage durations and collective doses

Reactor	Duration [days]	Collective dose [man·mSv]
Kalinin 2	8	67.2
Rostov 1	13	22.9
Rostov 2	5	10.1

New reactor on line

Rostov 3 with a VVER-1000 MWe type reactor (project V-320) was put into commercial operation on 17 September 2015.

Issues of concern in 2015

- New programme of radiation protection optimization at Concern Rosenergoatom NPPs for the period 2015 – 2019.
- Results of 2014 collective dose budget for all Russian nuclear power plants and projects for 2015.
- Putting into operation new automated equipment (AKIDK-401) at Kalinin NPP for dose control to the skin and lens of the eye.
- Complex of organizational and technical actions aimed at decreasing doses of utilities' employees and contractors: implementation of special protective clothes at Balakovo NPP, optimization of work for recharging of gamma flaw detectors at Kola NPP, use of new type manipulator for SG tube plugging at Rostov NPP.

SLOVAK REPUBLIC

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
VVER	4	163.414
REACTORS DEFINITIVELY SHUTDOWN OR IN DECOMMISSIONING		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
VVER	2	Not included in ISOE
GCR	1	Not included in ISOE

2) Principal events of the year 2015

- *Events influencing dosimetric trends*

  - Bohunice NPP (2 units): The total annual effective dose in Bohunice NPP in 2015, calculated from legal film dosimeters, was 398.298 man mSv (employees – 124.326 man mSv, outside workers – 273.972 man mSv). The maximum individual dose was 5.288 mSv (contractor). Without internal contamination. Without anomalies in radiation conditions.
  - Mochovce NPP (2 units): The total annual effective dose in Mochovce NPP in 2015, evaluated from legal film dosimeters and E50, was 255.357 man mSv (employees – 87.753 man mSv, outside workers – 167.594 man mSv). The maximum individual dose was 2.62 mSv (contractor worker).

- *Outage information*

  Bohunice NPP:
  - Unit 3 – 46.4 day major maintenance outage. The collective exposure was 302.136 man mSv from electronic operational dosimetry
  - Unit 4 – 19.8 day standard maintenance outage. The collective exposure was 117.286 man mSv from electronic operational dosimetry.

  Mochovce NPP:
  - Unit 1 – 27.25 day standard maintenance outage. The collective exposure was 143.314 man mSv from electronic operational dosimetry.
  - Unit 2 – 19.3 day major maintenance outage. The collective exposure was 85.62 man·mSv from electronic operational dosimetry.

- *Component or system replacements, Unexpected events/incidents, New reactors on line, Reactors definitively shutdown*

  - Mochovce NPP – The computerised central radiological data system was finished.

- *Unexpected events/incidents*

  - Bohunice NPP - Unexpected exposure during the outage of Unit 3: during the removal of foreign material found in an internal part of the reactor, the contractor caught it in his hand for 18 sec. After the investigation, the assigned equivalent dose to the skin was 437 mSv and the equivalent dose to the extremity was 30 mSv. The contractor violated the RP rules – he performed work without approval of the RP dept., and he did not stop the work when he heard the warning signals of the EPD.

3) Report from Authority

- Licensing process of the NPP Mochovce, Units 3 and 4.
- Decommissioning of JAVYS NPP, inspection.
- Inspections of outages in all operated units.

SLOVENIA

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	1	790

2) Principal events of the year 2015

- *Events influencing dosimetric trends*
  - Refuelling outage duration of 36 days (April 11th – May 16th, 2015). Outage collective dose was 690 man·mSv.
  - A modification related to reactor vessel up-flow conversion was performed efficiently to prevent fuel failures due to cladding fretting in the upper core baffle region.
- *Regulatory requirements*

  Technical Plans (refer to Slovenian 7th Report on Nuclear Safety):

  Post Fukushima up-grade projects are going on. The first phase of the Safety Upgrade Programme (SUP) was completed in 2013 with installation of passive containment hydrogen recombiners and a passive post-accident filter system. The modifications for the second phase of the SUP, planned to be concluded in 2018 include: flood protection of the nuclear island, operation support centre reconstruction, pressurizer power operated valve bypass, spent fuel pool alternative cooling, alternate cooling of reactor coolant system (RCS) and containment, emergency control room, upgrade of bunkered building electrical power supply, and replacement and upgrade of critical instrumentation.

  The third phase of the SUP will comprise a bunkered building with additional sources of borated and clean water with injection systems for the reactor cooling system / containment and steam generators capable of assuring reactor cooling for at least 30 days. The third phase will be completed by the end of 2021.

  Spent fuel dry storage at the plant location is scheduled for implementation in the year 2020.

3) Report from Authority

Slovenian Nuclear Safety Administration (SNSA) and Slovenian Radiation Protection Administration (SRPA) are performing regulatory control and inspection surveillance of the Krško NPP operation.
In 2015 and 2016, both regulatory authorities are putting effort into legislative amendments and their implementation. At the end of 2015 the Slovenian Ionising Radiation Protection and Nuclear Safety Act was amended. Other under-lying legislative acts concerning radiation protection and nuclear safety will be changed accordingly.
At the same time, legislative changes will be made to implement the new EU BSS directive.

SOUTH AFRICA

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	2	1,028.158 (TLD)

2) Principal events of the year 2015

- *Events influencing dosimetric trends*
- *Number and duration of outages*

<u>Koeberg Nuclear Power Station Unit 1 Refuelling Outage</u>

The Koeberg Nuclear Power Station Unit 1 was operational and on-line since December 27th, 2013 and was shut down for a refuelling outage on February 5th, 2015. During the power reduction and depressurization phases, no increase in fission product activity was observed. This confirmed the absence of any fuel defects in the reactor core. All of the fuel assemblies were tested for leaks via a sipping process during fuel unloading. The Koeberg Nuclear Power Station Unit 1 refuelling outage was completed on May 28th, 2015. The refuelling outage ALARA dose target was set at 1,167 man mSv, and the collective dose for the refuelling outage was 949.406 man mSv. A total of 81,201 entries were made into the reactor building for executing work activities, which equates to 0.011 mSv per entry. The highest collective dose to an individual registered during the refuelling outage was 8.364 mSv.

<u>Koeberg Nuclear Power Station Unit 2 Refuelling Outage</u>

The Koeberg Nuclear Power Station Unit 2 was operational and on-line since May 13th, 2014 and was shut down for a refuelling outage on August 31st, 2015. During the power reduction and depressurization phases, no increase in fission product activity was observed. This confirmed the absence of any fuel defects in the reactor core. All of the fuel assemblies were tested for leaks via a sipping process during fuel unloading. The Koeberg Nuclear Power Station Unit 2 refuelling outage was completed on December 3rd, 2015. The refuelling outage ALARA dose target was set at 1,152 man mSv, and the collective dose for the refuelling outage was 1,106.552 man mSv. A total of 77,797 entries were made into the reactor building for executing work activities, which equates to 0.014 mSv per entry. The highest collective dose to an individual registered during the refuelling outage was 5.45 mSv.

- *Component or system replacements, Unexpected events/incidents, New reactors on line*

During the refuelling outage on Unit 1, the lagging around the reactor vessel was replaced with new lagging. A total dose of 13.146 man mSv was accrued for the work versus a target of 15 man mSv.

During the refuelling outage on Unit 2, a modification was made to the fuel handling mast and in-line sipping instrumentation was fitted. A total dose of 12.726 man mSv was accrued for the work.

- *Unexpected events/incidents*

  One personal dose-meter alarmed while an individual was working on a primary system heat exchanger. The contact dose rate conditions on the component were found to be higher than anticipated.

SPAIN

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	6	430.25
BWR	1	2,466.80
All types	7	378.90
REACTORS DEFINITIVELY SHUTDOWN OR IN DECOMMISSIONING		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	1	438.36
BWR	1	119.90
GCR	1	0

2) Principal events of the year 2015

PWR

Almaraz NPP

- *Events influencing dosimetric trends (Outage information (number and duration), Component or system replacements, Unexpected events/incidents, New reactors on line, Reactors definitively shutdown…)*

  22nd outage of Almaraz Unit 2:

  - Duration: 40 days
  - Collective outage dose: 436.836 man·mSv
  - Maximum individual outage dose: 2.952 mSv

  - Replacement of Feed Water System pipes in 22nd outage of Unit 2
  - Modification in vessel seal cones in 22nd outage of Unit 2
  - Replacement of external nuclear instrumentation system and its associated wiring during 22nd outage of Unit 2.

- *New/experimental dose-reduction programmes*

  - Degreasing of the cavity walls and floor with solvent during 22nd outage of Unit 2.

Ascó NPP

- *Events influencing dosimetric trends (Outage information (number and duration), Component or system replacements, Unexpected events/incidents, New reactors on line, Reactors definitively shutdown…)*

  24th refuelling outage of Ascó 1:

  - Duration: 42 days
  - Collective outage dose: 498.73 man·mSv
  - Maximum individual outage dose: 3.948 mSv
  - Relevant activities from RP point of view performed during refuelling outage:
    - ✓ Reactor cavity injection design modification
    - ✓ H_2 Passive Autocatalytic Recombiners installation
    - ✓ Filtered reactor containment venting system installation

Trillo NPP

- *Events influencing dosimetric trends (Outage information (number and duration), Component or system replacements, Unexpected events/incidents, New reactors on line, Reactors definitively shutdown…)*

  - Outage duration: 31 days
  - Collective outage dose: 247.467 man·mSv
  - Maximum individual outage dose: 2.97 mSv.

- *Organisational evolutions*

  - New specialist who is undergoing training to be the future head of radiation protection.

Vandellós 2 NPP

- *Events influencing dosimetric trends (Outage information (number and duration), Component or system replacements, Unexpected events/incidents, New reactors on line, Reactors definitively shutdown…)*

  One outage with 57 days duration and a collective dose of 784.32 man·mSv. During the outage, the reactor vessel head was replaced. The total operational dose due to the reactor vessel head replacement, including the required plant design modifications, was 119.842 man·mSv.

BWR

Santa María De Garoña NPP

- *Events influencing dosimetric trends (Outage information (number and duration), Component or system replacements, Unexpected events/incidents, New reactors on line, Reactors definitively shutdown…)*

Date	Event	Collective Dose (man·mSv)
February 17th - March 6th	Control rod drive (CRD) removal and maintenance	14.338
September 3rd - December 30th	Reconditioning of drums containing waste built-in MICROCEL	14.106

Cofrentes NPP

- *Events influencing dosimetric trends (Outage information (number and duration), Component or system replacements, Unexpected events/incidents, New reactors on line, Reactors definitively shutdown…)*

  Chemical decontamination of the reactor recirculation system (B33) and reactor water clean-up system (G33) lines in the 20th outage.

- *Number and duration of outages*
  - 20th outage
  - 48 days
  - There was 1 forced outage to change damaged fuel elements (11 days).

- *New/experimental dose-reduction programmes*

  - <u>Improvement of the protection wardrobe used in reactor cavity</u>
    Use of ventilated hoods for specific work with high risk of personal contamination, to improve the workers' conditions in the reactor cavity.

- Chemical decontamination
  Chemical decontamination of the reactor recirculation system (B33) and reactor water clean-up system (G33) lines in the 20th outage.

- Auxiliary filtering systems in reactor building spent fuel pools
  Increase in the capacity of the auxiliary filtering systems, by providing 4 TRINUKE pumps in the 20th outage.

- Use of remote equipment
  Use of suction robot in reactor building spent fuel pools and remote equipment for the replacement of internal valves of the recirculation system (B33).

- Remote dose control
  The remote dose control system was used for a multitude of work in the dry well, like CRDs change, LPRMs change, SRMs and IRMs revision, chemical decontamination, internal valves replacement of recirculation system (B33) and others.

- Time reduction in high radiation areas and job control from access
  IP type TV cameras were installed in different points of the dry well and auxiliary building steam tunnel allowing the radiological control and supervision of the work from low radiation areas. Additionally, time-lapse TV cameras were installed on the refuelling and turbine floors. Screens were used at the dry well entrance to be able to check the component locations from a low radiation area. Besides, this tool was in use during the job planning stage.

- Temporary and permanent shielding
  The site continued implementation of permanent shielding in different plant areas.

- Training in scale models
  Training was performed using scale models for the following jobs: recirculation system plugs installation, installation of gauges in the main steam pipes, LPRM extraction and cut, CRD change-out and cleaning of the PRM conduit.

- *Organisational evolutions*

Change of the head of PR's Service in January, 2016, going to Ms. Amparo García Martínez.

SWEDEN

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	3	679
BWR	7	835
All types		788
REACTORS DEFINITELY SHUTDOWN OR IN DECOMMISSIONING		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
BWR	2	11

2) Principal events of the year 2015

Forsmark NPP

During 2015, a routine was implemented where the dose alarm on the EPD is set automatically according to the RWP (Radiation Work Permit). Expectation is that it will lower the majority of very low doses achieved during outages. Also during 2015, new RP training was introduced, including practical training in how to enter and act in the RCA. This training is mandatory for work in the RCA for all Swedish NPPs.

Forsmark 1: In the reactor systems, more extensive repair work on valves than anticipated led to a collective dose higher than expected during the outage. Also, replacement of cable entries to the containment led to higher doses than expected. Work on the travelling in-core probe system while the containment was pressurized led to unexpected spread of contamination. The outage lasted 41 days compared with a planned 35. An unplanned one week long stop occurred in the spring due to leakage in the reactor water cleaning system.

Forsmark 2: Extensive repair work in the reactor water cleaning system (the same problem that caused the unplanned stop at F1) led to slightly higher collective dose during the outage than planned and also led to a prolonged outage period. The dose rates in some reactor systems are still higher than before the system decontamination of 2012, and are still showing an upward trend. As at F1, work on the travelling in-core probe system led to unexpected spread of contamination, although not for the same reason as for F1. The outage lasted 27 days compared with a planned 15.

Forsmark 3: A one week forced stop due to replacement of leaking fuel occurred in the spring. When opening the reactor pressure vessel head, the iodine content in the air of the reactor hall was higher than expected and continued to be at a quite high level for some days. One person received internal contamination because of this.

The main modification during the planned outage was the exchange of the main generator. The performance of this job prolonged the outage from a planned 46 days to 142. But the dose due to this work was a minor part of the collective dose. More extensive repair work on valves in the reactor systems than anticipated (including more decontamination and scaffolding work) contributed to a higher collective dose than planned for the outage.

Barsebäck NPP

Evaluation of the choice of method for demolition – Work is continuing with the evaluation of various methods through studies and development projects as well as through the acquisition of international experience. The evaluation includes taking into account the principles of ALARA.

Business activity – System decontamination has meant that most areas in the reactor building have low dose rates. This means that the facilities are suitable for training and testing for the nuclear industry.

Ringhals NPP

As for previous years, the dose exposures in 2015 were dominated by large projects regarding modernization, life time extension and regulatory demands.

Source term control shows slightly decreasing trends in all reactors, but the source term investigations and trending concerning dose contributors such as Antimony, Silver and Cobalt continue.

Collective dose outcome in 2015 at Ringhals is 3.0 man-Sv, comparable with the annual doses in the previous three-year period.

During 2015, 10 individuals received doses ≥ 10 mSv. Almost everyone concerned received the dose during the work in the project RH/SP (alternative water supply) at Ringhals 2.

Based on experience from 2015, the RP department has taken a new approach for outage periods. The new approach, with new roles, starts in RA 2016 and means that Ringhals' own Radiation Protection staff will take over the operational management for RP work from the RP contractors on shift. The change is seen as very positive and will strengthen both the performance and safety culture.

The Radiation Protection Department has for several years been working on the follow-up of Contamination Events (CE) in exit monitors, both in the pre-monitors and in the final monitors. The measures taken have produced good results, and the trend since the more frequent monitoring started is downwards. Target goals at pre-monitors and in the final monitors, for 2016, have been lowered to 0.8 % respectively 0.3 % (1.0 % prior resp. 0.5 %).

Ringhals' release of radioactive substances is very low. Preliminarily, the radiation dose to the critical group calculated using the SSI (Authority)'s approved model from 2002, is 0.3 micro Sieverts in 2015. This is less than 1 / 200th part of the emission limit and far less than 1 / 1000th part of the radiation dose from the natural background.

The decision on the earlier final shut down of Ringhals 1 and 2 will need extra focus in certain areas, including expertise in radiation protection, available resources and not least the safety culture.

Oskarshamn NPP

In 2015 the radiation protection organization at OKG was pushing for "job rotation" for high dose work.

Effective system decontamination was conducted on the O2 plant for the project PLEX, and the reactor has been in outage from mid-2013 (so the source terms have decayed), which has had a positive impact on the dose outcome.

During the year, the focus has also been placed on FME (Foreign Material Exclusion) to optimize the conditions for clean systems. This has been accomplished through the creation of FME zones in the reactor hall and for large system rebuilds. Staff has been trained to establish a clear understanding of the importance of clean systems. To reinforce the importance and to have a direct responsibility, an FME-engineering services organisation was established.

A model for dose planning and department collective dose goals is under development.

On the basis of the decisions in 2015 to not restart the O2 reactor after completion of the upgrading project PLEX and to do the final shutdown of the O1 reactor by mid-2017, studies and analyses have been carried out concerning organization and the fact that OKG will need to manage both the production operation, service operation and decommissioning activities.

In 2015, there has also been a focus on development and improvements in the radiation protection area. As part of efforts to strengthen radiation protection support, radiation coaching services have been implemented.

Training activities have evolved, and the industry training Protection, Safety and Radiation Protection in practice was launched in January 2015 and has since then worked very well.

Measures have been taken, an information meeting has been held and workshops have been conducted with the intention of providing a better understanding of the requirements for the handling of radioactive sources.

Efforts have been made in 2015 regarding release of material as non-radioactive material, including the logistics of handling of materials. Internal follow-up supervision was directed against the ‘classification for release of material for free use’ activities at the end of the year, ahead of an official inspection in 2016.

OKG in 2015 remained under Authority (SSM) special supervision.

3) Report from Authority

The Swedish Radiation Safety Authority (SSM) is working on a draft of a new radiation protection law, and a complete set of radiation protection legislation framework, supporting the law. The regulations include nuclear safety, radiation protection, security and safeguards and will be completed in 2018.

SSM actively follows the planning of the decommissioning of the four reactors that close down in the 2016-2020 period, and performs its normal surveys of the operating nuclear reactors.

SWITZERLAND

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	Number of reactors	Average annual collective dose per unit and reactor type [man·mSv/unit]
PWR	3	573
BWR	2	1,234

2) Principal events of the year 2015

- *Events influencing dosimetric trends*

NPP Beznau
In 2015, long outages led to a collective dose in both units of 1,227 man mSv (around 2,000 persons). No incorporation was detected (detection threshold 1,000 Bq Co-60). The highest individual dose was 10.7 mSv. 52 persons had doses between 5 mSv and 10 mSv. 2 persons had doses > 10 mSv.

At Unit 1, the outage started on March 13th, and the following major projects were performed:

a) reactor vessel closure head replacement;
b) NDT inspection of reactor vessel;
c) NDT inspection of crossover legs;
d) replacement of containment ventilation cooler units;
e) integration of Emergency sealing water system;
f) integration of Emergency stand-alone power supply.

Because of findings in the reactor vessel, a sophisticated investigation and analysis of the backing material has to be performed. International expert groups were formed by AXPO and ENSI. Reconnection to the grid is planned for the end of 2016.

The Beta/Alpha Ratio of surface contamination at Unit 1 has been decreasing for the last couple of years. The ratio varies over several orders of magnitude. This new situation has been a challenge for the RP department.

Unit 2 has been in outage since August 13th. Reconnection to the grid occurred on December 23rd, as planned before. Unit 2 followed the same outage plan with the same projects as Unit 1.

In Unit 2 the reactor vessel showed no findings such as those on Unit 1.

NPP Gösgen
The outage led to a collective dose of 401 man mSv, with no incorporation, and 8.4 mSv as the maximum recorded annual individual dose. Zn-64 injection was started in 2005, leading to a reduction of the average dose rate of primary circuit components of about 62 %. The reduction in one single year is around 7 %.

NPP Leibstadt

The 2015, outage dose of 1,189 man·mSv was within a reasonable range of the dose goal (1,150 man·mSv). The slight overrun was mainly due to the failure of the reactor building crane, while the reactor pressure vessel head was hanging on it. The Soft Shutdown and optimized operations lowered the dose rate in the Residual Heat Removal System (RHR) as much as a factor of 2. There were two forced outages due to lube oil malfunctions in the turbine/generator area, with no impact to RP.

NPP Mühleberg

KKM had a "normal" outage leading to 710 man mSv as planned (no incorporation, max individual dose of 7.6 mSv) with the following special work: Dumping and cleaning of the suppression system (torus), Extensive NDT program in the drywell, and Integrated Leak Rate Testing of the drywell. This outage also included refitting of the crane in the reactor hall (4 years before planned shutdown for decommissioning).

3) Report from Authority

The Swiss Federal Nuclear Safety Inspectorate (ENSI) acknowledges as a general rule, that planning by the operators of nuclear facilities in the field of radiological protection is of a high standard so that the resulting collective doses generally closely match the projected values.

ENSI has identified an increasing public interest in data concerning radiation and has therefore introduced a number of new concepts. Typical of these is the online availability, since the start of 2015, of monthly nuclear power plant releases. There is also a new development concerning the data from the network for automatic measurement of dose rates in the vicinity of nuclear power plants (MADUK). It is now possible to view dose rates since 1994 averaged over periods of ten minutes, one hour and one day. A special chapter of this report deals with C-14 releases, which are regularly the subject of enquiries from interested parties.

UKRAINE

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
VVER	15	620

In 2015, the dose rate per unit was worse than in 2014. The common reason could be defined as increased duration and scope of radiation work when performing overhauls and planned repairs at ZNPP Units 2 and 5 and all RNPP Units (incl. an overhaul outage at Unit 4) as compared with the previous year. This degradation is also related to a significant scope of rehabilitation work performed to extend the life of SUNPP Unit 2 beyond its original design lifetime and involving a significant number of contracted personnel to perform these activities.

UNITED KINGDOM

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	1	50.91
GCR	14(1)	66.58
REACTORS DEFINITIVELY SHUTDOWN OR IN DECOMMISSIONING		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
GCR	20(2)	90.20

Notes
(1) 14 Advanced Gas-Cooled Reactors
(2) 20 Magnox Reactors.

2) Principal events of the year 2015

The majority of Advanced Gas Reactors recorded low annual collective radiation exposures, in the range 20 – 40 man·mSv, with the exception of Hinkley Point and Hunterston who recorded collective radiation doses of approximately 340 man·mSv and 450 man·mSv respectively. The doses at the latter two reactor sites are dominated by inspections carried out inside the vessels, to support the long term safety case for operation.

Sizewell B, the only PWR in the United Kingdom, did not have an outage in 2015 so the collective radiation exposure for the year was low. The construction and commissioning of a Dry Fuel Store at Sizewell B continued. The Dry Fuel Store is intended to store all of the station's expected arising of spent fuel. The first irradiated fuel is expected to enter the storage building in the late autumn of 2016.

2015 marked the final year of operation of the last generating Magnox reactor (1st generation gas-cooled reactor) in the United Kingdom, with Wylfa entering in to decommissioning in December. Two further sites have been declared fuel free, meaning Wylfa will now be the only site in the defuelling phase of decommissioning. The rest of the Magnox sites are in Care and Maintenance preparations, Care and Maintenance being a passively safe and secure state where radiation levels are left to decay naturally. The first site is anticipated to enter this state in 2019.

There is a large amount of nuclear new build planned and proposed in the UK. EDF Energy plans to build twin EPRs at Hinkley Point and has proposed the same at Sizewell. Similarly, Horizon Nuclear Power plans to build twin GE-Hitachi Advanced Boiling Water Reactors at Wyfla Newydd and has proposed the same at Oldbury. Three Westinghouse AP1000 units are also proposed at Moorside by the Nu Generation consortium. These proposals are undergoing generic design assessment by the UK regulators. A final investment decision on Hinkley Point is expected from EDF Energy in 2016. EDF and Chinese General Nuclear have also agreed to advance plans for two Chinese design PWRs at Bradwell.

UNITED STATES

1) Dose information for the year 2015

ANNUAL COLLECTIVE DOSE		
OPERATING REACTORS		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	65	440.499
BWR	34	1,222.139
All types	99	708.941
REACTORS DEFINITIVELY SHUTDOWN OR IN DECOMMISSIONING		
Reactor type	**Number of reactors**	**Average annual collective dose per unit and reactor type [man·mSv/unit]**
PWR	7	207.866
BWR	3	185.117

2) Principal events of the year 2015

Summary of national dosimetric trends

The USA PWR and BWR occupational dose averages for 2015 reflected a continued emphasis on dose reduction initiatives at the 99 operating commercial reactors. Four PWR units continued transition to the SAFSTOR/decommissioning phases. San Onofre Units 2&3 are scheduled to have an accelerated transition to decommissioning for the site. Crystal River and Kewaunee have moved into SAFSTOR for a 10–20 year period after the spent fuel pools are emptied and spent fuel is relocated to the dry cask storage pad.

Reactor Type	Number of Units	Total Collective Dose	Avg Dose per Reactor
PWR	65	28,632.42 person mSv	440.499 person mSv/unit
BWR	34	41,552.73 person mSv	1,222.139 person mSv/unit

The total collective dose for the 99 reactors in 2015 was 70,185.15 person mSv, a decrease of 1.5% from the 2014 total collective dose of 71,244.6 person mSv from 99 operating reactors. The resulting average collective dose per reactor for USA LWR was 708.94 person mSv/unit or a 4.6% decrease from 2014 (742.13 person mSv/reactor unit).

Two individuals received between 20–30 mSv at a US PWR site in 2015.

US PWRs
The total collective dose for US PWRs in 2015 was 28,632.42 person mSv for 65 operating PWR units. The 2015 PWR total collective dose was 14% lower than the 2014 US PWR total collective dose of 33,263.97 person mSv. The 2015 average collective dose per reactor was 440.499 person mSv/PWR unit. US PWR units are generally on 18-month refuelling cycles. The US PWR refuelling frequency can create fewer refuelling outages in certain years in the US, for example 2013, 2016 and 2019.

The US PWR sites that achieved annual site doses of under 100 person mSv in 2015 were:

- Callaway 32.8 person mSv
- Davis Besse 9.9 person mSv

US BWRs

The total collective dose for US BWRs in 2015 was 41,552.73 person mSv for 34 operating BWR units. The 2015 BWR total collective dose was 20 % higher than the 2014 US BWR total collective dose of 33,363.97 person mSv for 34 operating BWR units. The 2015 average collective dose per reactor was 1,222 person mSv/BWR unit.

Most US BWR units are on 24-month refuelling cycles. The highest 2015 annual US BWR site dose was 5,016.66 person mSv at LaSalle County 1, 2. US BWRs have faced occupational dose challenges due to high CRUD levels on piping, and power up-rates modifications in 2015.

- *New plants on line/plants shut down*

  Watts Bar 2, a TVA Westinghouse Ice Condenser unit, commenced commercial operations in early 2016. Southern Company is continuing the construction of two new PWRs at the Vogtle site in Georgia. South Carolina Electric & Gas is constructing two new PWRs on the V. C. Summer site. Upon completion of these reactors, the US may be operating 104 reactors in the near future, if there are no additional permanent shutdowns at other US sites.

  Zion Units 1 and 2 located on Lake Michigan north of Chicago started decommissioning in 2010. Energy Solutions is responsible for the decommissioning of the Zion site. Vermont Yankee, Kewaunee, San Onofre 2, 3 and Crystal River transitioned into the decommissioning phase during the period of 2013-2014.

  Vermont Yankee Nuclear Power Station was a 1,912 MWt BWR which began operations in 1972. The reactor was permanently shut down on December 29th, 2014. The nuclear fuel was removed on January 12th, 2015. Entergy, site owner, has stated that all spent nuclear fuel will be placed in dry cask storage and the plant will be placed in SAFSTOR until the owner is ready to fully decommission the site. License termination is scheduled to take place by 2073.

- *Major evolutions*

  Four US PWRs continued their transition to decommissioning status. The 2015 (as compared to 2014) annual occupational doses for selected US units undergoing SAFESTOR or decommissioning are as follows:

Site	2014	2015
• Crystal River	6.96 person mSv	7.00 person mSv
• San Onofre 2, 3	13.69 person mSv	12.02 “ “
• Kewaunee	19.64 person mSv	43.91 “ “
• Humboldt Bay	123.81 person mSv	43.91 “ “
• Zion 1, 2	787.30 person mSv	1,426.05 “ “

- *Safety-related issues*

  Some US PWRs with over 40 years of operations performed full baffle bolt inspections on the vessel core barrel. Salem 1 replaced 190 baffle bolts and Indian Point 2 replaced 278 baffle bolts as emergent work scope during their scheduled refuelling outages

- *New/experimental dose-reduction programmes*

  Numerous RPMs are implementing the H3D CZT detector system developed by the University of Michigan which achieves 3D individual isotopic mapping of in-plant components and piping. The new ALARA tool has been found to be effective in verifying the adequacy of temporary shielding and in other RP applications.

Technical plans for major work in 2015

FLEX equipment and programs were fully implemented in 2015 at US licensees. Two regional FLEX Centres were established in Memphis, Tennessee and Phoenix, Arizona to serve the US sites in the unlikely event of a reactor accident. Each site maintains a smaller inventory of FLEX equipment in seismically qualified buildings.

PWRs continue to perform MSIP treatments (piping squeeze to relieve metallurgical stresses) on plant piping. Boric acid leak remediation is also an on-going emphasis at US PWRs.

Extensive source term reduction initiatives were initiated at the LaSalle County site (BWR) in 2015 to reduce CRUD in the BWR piping and reactor cavity.

US fleets and alliances are continuing to standardize RP procedures and policies across the fleets/alliances to improve efficiency of RP operations and minimize confusion of traveling RP techs.

Due to the significant increase in single unit nuclear sites in the US considering early transition to SAFSTOR/Decommissioning, US nuclear senior managers have initiated a program to improve the efficiencies of nuclear plant operations and achieve lower operating costs. Low natural gas prices and wind energy coming onto the US grid have created economic pressure on operating nuclear units at some US utilities. The New York State Legislature with the Governor’s support passed legislation to keep the Fitzpatrick and Ginna stations operating: giving credit of the renewable, carbon-free generation that nuclear units provide to the state.

Loading of spent fuel assemblies into dry casks continued in 2015. US BWRs continue to replace dryers in the upper reactor internals.

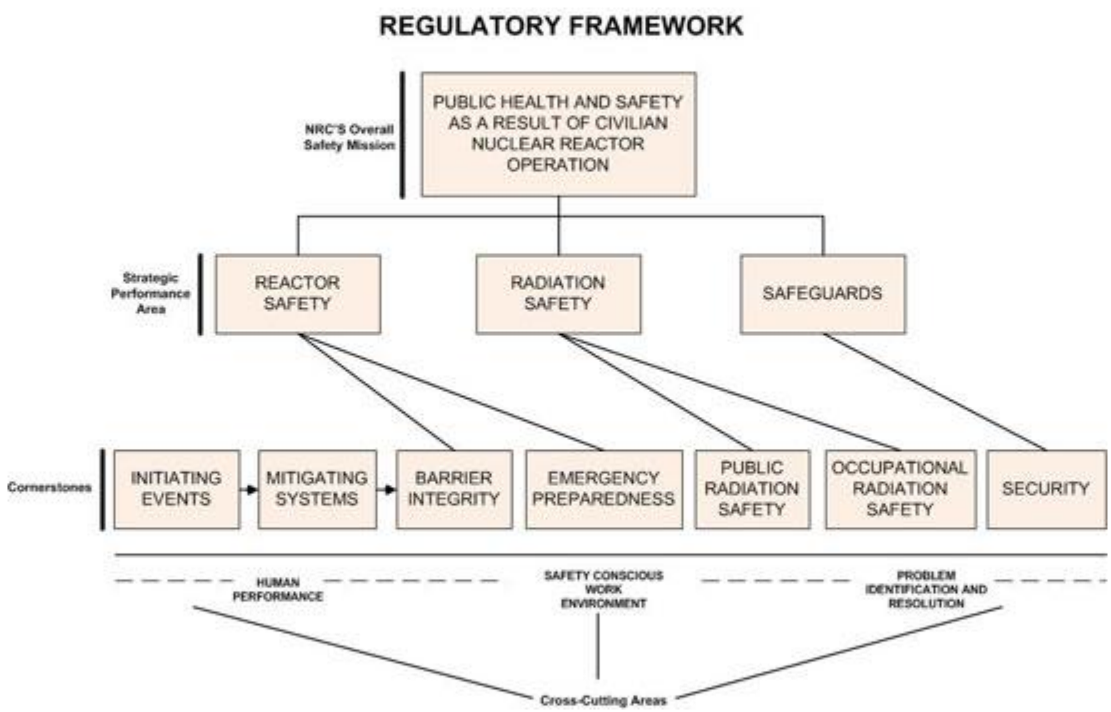
The Zion Units 1 &2 site removed most of the contaminated equipment in 2015. The turbine and containment building are undergoing demolition in 2016.

Regulatory plans for major work in 2014

NRC’s Reactor Oversight Program - Regulatory Framework

The U.S. Nuclear Regulatory Commission’s (NRC) regulatory framework for reactor oversight is shown in the diagram below. It is a risk-informed, tiered approach to ensuring plant safety. There are three key strategic performance areas: reactor safety, radiation safety, and safeguards. Within each strategic performance area are cornerstones that reflect the essential safety aspects of facility operation. Satisfactory licensee performance in the cornerstones provides reasonable assurance of safe facility operation and that the NRC's safety mission is being accomplished.

Within this framework, the NRC's operating reactor oversight process provides a means to collect information about licensee performance, assess the information for its safety significance, and provide for appropriate licensee and NRC response. The NRC evaluates plant performance by analysing two distinct inputs: inspection findings resulting from NRC's inspection program and performance indicators (PIs) reported by the licensees.



Occupational Radiation Safety Cornerstone and 2015 Results

Occupational Radiation Safety - The objective of this cornerstone is to ensure adequate protection of worker health and safety from exposure to radiation from radioactive material during routine civilian nuclear reactor operation. This exposure could come from poorly controlled or uncontrolled radiation areas or radioactive material that unnecessarily exposes workers. Licensees can maintain occupational worker protection by meeting applicable regulatory limits and ALARA guidelines.

Inspection Procedures – There are five attachments to the inspection procedure for the occupational radiation safety cornerstone:

IP	71124	Radiation Safety-Public and Occupational
IP	71124.01	Radiological Hazard Assessment and Exposure Controls
IP	71124.02	Occupational ALARA Planning and Controls
IP	71124.03	In-Plant Airborne Radioactivity Control and Mitigation
IP	71124.04	Occupational Dose Assessment

IP	71124.05	Radiation Monitoring Instrumentation

Occupational Exposure Control Effectiveness - The performance indicator for this cornerstone is the sum of the following:

- Technical specification high radiation area occurrences
- Very high radiation area occurrences
- Unintended exposure occurrences

Occupational Radiation Safety Indicator	**Thresholds**		
	(White) Increased Regulatory Response Band	(Yellow) Required Regulatory Response Band	(Red) Unacceptable Performance Band
Occupational Exposure Control Effectiveness	> 2	> 5	N/A

Those units that do not cross the thresholds receive a green finding or no findings. The latest ROP Performance Indicator Findings can be found at http://www.nrc.gov/NRR/OVERSIGHT/ASSESS/pi_summary.html.

Additional background information can be found on the Detailed ROP Description page at http://www.nrc.gov/reactors/operating/oversight/rop-description.html.