# ANNEX 6 Evaluation of the Safety Performance Indicators Set
**(year 2012)**

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Appendices:

## A. INTRODUCTION

State Office for Nuclear Safety (SUJB) executes the state administration and supervision of the utilisation of nuclear power and ionising radiation in order to assure achieving a required safety level. As the focus of the supervision consists in the evaluation and assessment of nuclear safety related activities and their results, SÚJB annually evaluates an achieved level of nuclear safety of operation of Dukovany NPP by using Safety Performance Indicators.

The Safety Performance Indicators evaluate four areas of the NPP operation:

1. Events,
2. Safety Systems Performance,
3. Barriers Integrity,
4. Radiation Protection.

The evaluation results of Safety Performance Indicators in the form of graphs for the monitored period (2007 - 2012 for Dukovany NPP and 2007 – 2012 for Temelin NPP) are stated in appendices. The graphs mostly represent local values in the form of sum totals or averages of the unit values. Only for Safety System Unavailability, the indicated values are also at the level of the systems and for Barriers Integrity at the unit level.

Input data for the evaluation were acquired both from documents submitted by the operator and by SÚJB supervisory activities at Dukovany NPP and Temelin NPP.

## B. EVALUATION OF THE SET OF SAFETY PERFORMANCE INDICATORS FOR DUKOVANY NPP

This section includes an evaluation of particular indicators of the monitored areas of operation of Dukovany NPP and their graphic representation is shown in Annex – Part I.

The evaluation of Safety Performance Indicators for 2012 confirms a constant high level of assurance of nuclear safety and radiation safety in power generation in Dukovany NPP.

### 1. Events

Group 1.A – Reportable events

The basis for the group 1.A indicators is the evaluation of reportable events according to the NPP Event specification. The indicator 1.A.1 "Number of Reportable Events" was included into the set of Safety Performance Indicators in 2003 and it superseded indicator "The Number of Safety Related Events".

There were 55 events assigned to the indicator 1.A.1 "Number of Reportable Events" (graph 1.A.1) in 2012. The highest value of this indicator in past six years, 61 events, was achieved in 2011, which was the highest value since 2003.

As well the trends of BSE (Bellow Scale Events) and SSE (Safety Significant Events) values are shown on graph of the indicator 1.A.1. The number of events evaluated according to the International Nuclear Event Scale (INES) for the significant part of the monitored period shows a steady state with an increase of approximately 100% in 207 and 2011 and return back in 2012.

The indicator "Human Factor" (graph 1.A.2) by means of index HFI expresses a share of human failures in total number of reported events. This indicator both in the number of the events affected by human factor and in its index in the period under consideration fluctuates with a period of several years; we can see a growing trend in the shown period.

Group 1.B – Actuation of the protection and limitation systems

There was no unplanned automatic reactor scram in past two years and any of the reactors of Dukovany NPP had to be manually shutdown in the shown period. Results of the indicator "Unplanned Unit Scrams" are shown on graph 1.B.1,2.

The number of actuation of automatic power reductions by RLS3 rapidly increased to 7 in the last year, primarily after failures and/or forced shutdown of important components. The results of indicator "Automatic Power Reduction/Limitation" are shown in a common graph 1.B.3-5.

After eliminating cause of an increased number of "Control Rod Drops" - insufficient cooling of newly installed components of reactor control system there was no Control Rod Drop during past three years (graph 1.B. 6).

Group 1.D – Limits and Conditions

The indicator "Violations of the Limits and Conditions" (graph 1.D.1) fluctuates from one to three events per year.

The indicator "Exemptions from the Limits and Conditions" (graph 1.D.3) reached the zero value as in previous year. This means that there was no approval of the Exemptions from the Limits and Conditions were required in 2012. When evaluating the whole six-year period, we can see one approved Exemption from the Limits and Conditions in 2012.

## 2. Safety Systems Performance

Group 2.A – Safety System Unavailability

The group is monitored by means of indicator "Safety System Unavailability" for specific safety systems, see graphs 2.A.1.a – g.

The graphs of the system sub-indicators show an increase in the value for systems HA, HNPG and SHNPG in 2011. This situation was unique and in 2012, the values of the above mentioned sub-indicators returned back to the usual level. Value of unavailability for diesel-generators is very significantly influenced by carrying out the online maintenance (OLM) in each individual year (there was no OLM in 2011 and 2012).

Group 2.B – Failure of safety systems

According to the indicator "Starting Failures of Safety System" (graph 2.B.1), in 2012 three failure of SHNPG occurred. Other monitored systems did not fail in their start-up. Similarly, the behaviour of safety systems in operation is monitored in the indicator 2.B.3. No failure occurred in safety system operation since 2005.

## 3. Barriers Integrity

Group 3.A – Nuclear fuel

The state of nuclear fuel is monitored by the indicator "Fuel Reliability Index" (FRI, graph 3.A.1) and the indicator "The Number of Leaky Fuel Assemblies" (graph 3.A.2). The fuel reliability formula is based on the empirical formulas and its results thus must be considered in terms of possible failure load. In practice, two or three levels of the values of the Fuel reliability factor are assessed: more than 19 Bq/g – the reactor core contains, with great probability, one to two defects; less than 19 Bq/g – the reactor core does not contain, with great probability, any fuel defect; all design values of the Fuel reliability factor less than 0.04 Bq/g are just corrected to the limit 0.04 Bq/g by reason of limited operation of the empirical formulas. Most of annual values of indicator FRI in past six years are at the level 0.04 Bq/g. The highest value of FRI (0,98 Bq/g) was detected at the end of campaign 2007 at Unit 1. During outage, one leaky fuel assembly was identified and it was discarded. The second highest value (0,44 Bq/g) was detected at the end of campaign 2010. In total seven leaky fuel assemblies were discarded to the spent fuel storage pool in the whole operation period of Dukovany NPP.

Group 3.B – Containment

Graph 3.B.1 of the indicator evaluates, through the results of the Containment periodic integral tightness testing, the tightness condition of hermetic areas. Tightness tests with the period of 2 years have been ongoing since 2011, for Units 1 and 3 in odd years, and for Units 2 and 4 in even years. The year 2012 confirms trend of systematic increase of Dukovany NPP unit tightness, which has been recorded on all four units since 2001, except for two minor

deviations. All time low leakage values for 24 hours are recorded on Unit 1 and 4 during the Periodic integral tightness testing. In terms of containment tightness, the best results are recorded on Unit 4 on a long-term basis.

## 4. Radiation Protection

Group 4.A – Staff

The indicator "Collective Effective Dose per Unit" (graph 4.A.1) monitors collective effective dose of NPP staff, suppliers and visitors converted per one unit. The indicator fluctuated in last six years on the value less than 0.2 Sv/year, in 2008 it dropped close to 0.1 Sv/year. Graph 4.A.2 of the indicator "Collective Effective Dose" shows that this trend relates both to NPP staff and to suppliers.

At the indicator "Specific collective Dose per Capita" (graph 4.A.3), fluctuated between 0.15 and 0.06 mSv/year at the NPP staff, and between 0.52 and 0.34 mSv/year at the suppliers. Indicator "Maximum Individual Effective Dose" (graph 4.A.4) was fluctuated in a similar way as other indicators. At the suppliers in the years 2007 and 2009 it slightly exceeded 10 mSv/year. Both mentioned indicators also document that supplier's staff are exposed to radiation more than Dukovany NPP staff.

The indicator "The Number of Workers with Special Decontamination" (graph 4.A.5) shows permanently very low level and documents a high safety level at work with ionizing radiation sources of more than 1,800 radiation employees of Dukovany NPP. In 2008 and 2011, four employees had to be subject to special decontamination, which are the highest number for the whole period under consideration. In 2009, no radiation staff had to be subject to special decontamination.

Group 4.B – Radioactive Releases

The indicators "Gaseous Releases" and "Liquid Releases" evaluate the operation of Dukovany NPP in terms of radioactive releases. Their graphs 4.B.1 and 4.B.2 document that the committed effective doses from the releases are in both cases lower for the population in a calendar year than the limits (the limit for gaseous releases is 40 μSv and 6 μSv for liquid releases).

## C. EVALUATION OF THE SET OF SAFETY PERFORMANCE INDICATORS FOR TEMELIN NPP

This section includes an evaluation of particular indicators of the monitored areas of Temelin NPP operation and their graphic representation is shown in Annex – Part II.

The operation of Temelin NPP was evaluated by means of safety indicators in 2012 for the seventh time. Similar statistic comparison may be performed for this period as at Dukovany NPP.

### 1. Events

Group 1.A – Related events

Since 2007, the basis for the group 1.A indicators has been the evaluation of reportable events according to the NPP Event specification that are evaluated in feedback process (RE – Related events) such as at Dukovany NPP. The indicator 1.A.1 "Related Events" was included in the set of Safety Performance Indicators and it superseded indicator "The Number of Safety Related Events". The biggest number of events in past six years was recorded in 2009 – 85 events. The number of events was considerably dropping till 2012 when 49 events were recorded. The number of events evaluated according to INES has a declining trend for events evaluated INES0, from 24 events in 2007 to 10 in 2012. The number of events evaluated INES1 fluctuated between 0 (2010) and 3 (2009, 2012).

At indicator "Human Factor", graph 1.A.2, the number of events with HF in 2012 decreased to 19, which is close to the situation before 2011. However, due to the significant decrease in the total number of events, they hold much more percentage – 39%. The comparison with older data is not possible due to a change in the methodology of monitoring and evaluation of the number of events in 2007.

Group 1.B – Actuation of the protection and limitation systems

There was no unplanned ROR (reactor scram on the basis of primary causes in PRPS system) in 2012 at Temelin NPP. Therefore, no actuation of ROR occurred for whole six years period at Unit 2. At Unit 1 there was three actuation of ROR during past six years. No reactor shutdown by LS(d) type was recorded at NPP Temelin during past three years.

The number of actuation of safeguards in the form of limitation system by other types (a, b, c) decreased in general during whole six years period, in 2012 there was only one LS(a) actuation (graph 1.B.3-5).

Group 1.D – Limits and Conditions

In 2012, there was four case of Violation of the Limits and Conditions (graph 1.D.1), which is more than twice more than average previous five years. It means, Temelin NPP was out of the acceptable level on a long-term basis, i.e. one violation of the Limits and Conditions per unit per year.

No "Exemptions from the Limits and Conditions" were approved by SÚJB in the last year. In years 2010 and 2011was approved two respectively three planned changes (graph 1.D.3).

## 2. Safety Systems Performance

Group 2.A – Safety System Unavailability

For indicator "Safety System Unavailability" (graphs 2.A.1a-g), the unavailability had considerably improved for almost all systems in 2010, except for hydro-accumulators, where improvement occurred in 2009.

Group 2.B – Failure of safety systems

During past six years, four causes starting failure occurred (DGS in 2007 and 2009, TX in 2007 and TQx3 in 2011), see indicator "The Number of Starting Failures" (graph 2.B.1). Failure during operation occurred more frequently in the monitored period, a total of 13 cases in last 3 years, see indicator "The Number of Starting Failures" (graph 2.B.3).

## 3. Barriers Integrity

Group 3.A – Nuclear fuel

The state of nuclear fuel is monitored by the indicator "Fuel Reliability Index" (FRI, graph 3.A.1) and the indicator "The Number of Leaky Fuel Assemblies" (graph 3.A.2).

In 2010 and 2011, the supplier of fuel for Temelin NPP was changed (newly the TVSA-T type). With a new fuel, three leaking fuel assemblies were detected; all leakage occurs during the first campaign with a new fuel.

Group 3.B – Containment

In this group, there is only one indicator, which evaluates the results of the Periodic integral tightness testing, tightness condition of hermetic areas in graph 3.B.1. Last Periodic integral tightness testing was performed in 2011 at Unit 1 and in 2009 at Unit 2. The trend of measurements performed in previous years corresponds to design expectations as well as international experience.

## 4. Radiation Protection

Group 4.A – Staff

The indicator "Collective Effective Dose per Unit" (graph 4.A.1) monitors collective effective dose of NPP staff, suppliers and visitors converted per one unit. The indicator "Collective Effective Dose" (graph 4.A.2) monitors total collective effective dose of Temelin NPP in distribution of NPP staff and suppliers. The development from 2009 shows that the steady state, around which the individual annual values fluctuate, was achieved. Within the fluctuation, both indicators dropped to the lowest levels since commencement of operation.

The similar development can be also seen for indicators "Specific Collective Dose per Capita" (graph 4.A.3) and "Maximum Individual Effective Dose" (graph 4.A.4). It is apparent from all indicators, where the doses for NPP staff and suppliers are distinguished, that exposure of suppliers' staff to radiation is much higher than exposure of Temelin NPP staff.

Occurrence of only one case in the indicator "The Number of Workers with Special Decontamination" (graph 4.A.5) in past six years documents a high safety level at work with ionizing radiation sources of approximately 1,200 radiation employee of Temelin NPP.

Group 4.B – Radioactive Releases

Graph 4.B.1 "Gaseous Releases - Committed Effective Dose" represents the exposure of individuals from the most exposed population group acquired by calculation from the authorized model for current radionuclide effluent to the air and the current meteorological situation in the evaluated year. The values show that the SÚJB annual authorized limit of 40 μSv is drawn on the level of approximately 0.1% in the last years.

Graph 4.B.2 "Liquid Releases - Committed Effective Dose" represents the exposure of individuals from the most exposed population group acquired from the authorized model for current radionuclide effluent to the stream and the current hydrological situation in the evaluated year. The SÚJB annual authorized limit of 3 μSv was drawn on the level of approximately 20% in 2012.

## D. CONCLUSION

Based on the results of particular Safety Indicators for 2012 it may be stated that the previous high level of nuclear and radiation safety in power generation at **Dukovany NPP** was confirmed in all monitored areas.

It seems that a strong increase in the number of events in 2011 was only temporary; in 2007 the number of events decreased by10%. In general, during past six years the number of events increased approximately by10%. Severity of events has not virtually changed for last 4 years (except for 2011). The values of the indicator "Human Factor" indicate sustained difficulties of the NPP with the human factor, which caused 35% of "Reportable Events".

Difficulties with new I&C System were solved and there was no unit scram or control rod drop during past two resp. three years.

From 2008 approximately two causes violations of the Limits and Conditions a year occurred. Almost all violations of the Limits and Conditions were caused by human failure. The values of the other indicators related to the Limits and Conditions of safe operation did not deviate from a long-range average.

The values of the DGS unavailability (indicator "Safety System Unavailability") significantly dropped from 2011, but strong peak at HA, HNPG and SHNPG unavailability in 2011 occurs. All values (including peak values) are well below the value of $10^{-2}$, which is regarded as the acceptable limit for the value of safety system unavailability. There was (except TH system) at least one start-up failure of each safety system in 2011

In the area "Barriers Integrity", no leaky fuel assembly from 2007 was occurred. The results of integral tightness testing further increased at all units.

Based on the above mentioned results of the indicators of the area "Radiation Protection" it may be stated that radiation protection assurance at Dukovany NPP is on a high level. The values expressing collective and individual effective dose probably stabilised near the level achieved in 2008.

Both liquid and gaseous effluents are maintained on a very low level.

The results of the evaluation of a set of Safety Indicators for **Temelin NPP** show that nuclear and radiation safety of power plant is at the level usual for NPP with pressurized water reactors.

In the area “Events”, a considerable decrease in "Safety Related Events" continued from 2010 and dropped to the minimum number from the start of operation. Similar trends can be seen in the events evaluated according to the International Nuclear Event Scale (INES). The number of events with human factor effect has a growing trend almost throughout the monitored period, in both absolute and relative terms.

A low number of reactor scrams by means of PRPS during past six years occurred and there was no reactor scram by means of LS from 2010. The actuation of other limiting functions of LS is decreasing also (only one cause of LS(a) in 2012).

In the area “Limits and Conditions”, the violations of the Limits and Conditions increased up to 4 cases in 2012. In 2010 and 2011, two or three Exemptions from the Limits and Conditions were approved.

The value of the general safety system unavailability in the area "Safety System Unavailability“ dropped in 2010 under the best level existing so far from 2007 and continues to show a positive development. The start-up reliability of all safety systems considerably improved, when from 2010 only one start-up failure occurred in total. In comparison with this, deteriorating of safety systems in running continued. The worst was the year 2011 when together 7 running occurred.

In terms of fuel tightness, in the area "Barriers Integrity" after the change of fuel supplier in 2010, three leaking fuel assemblies were detected so far, all of them during the first campaign.

The values of the indicators for the area "Radiation Protection" show a decrease for a predominant part of the period under consideration and some of them reached the lowest level since commencement of operation. A low drawing on allowable limits is documented in the group "Radioactive Effluents”.

**The above summary of the results of particular areas of the set of safety indicators provided a sufficient overview of the state and assurance of nuclear and radiation safety in operation of Dukovany and Temelin NPPs. Within the inspection activities, the inspectors from the State Office for Nuclear Safety will pay more attention to the reasons for the growing trend as well as the proportion of LF events.**

## E. ABBREVIATIONS:

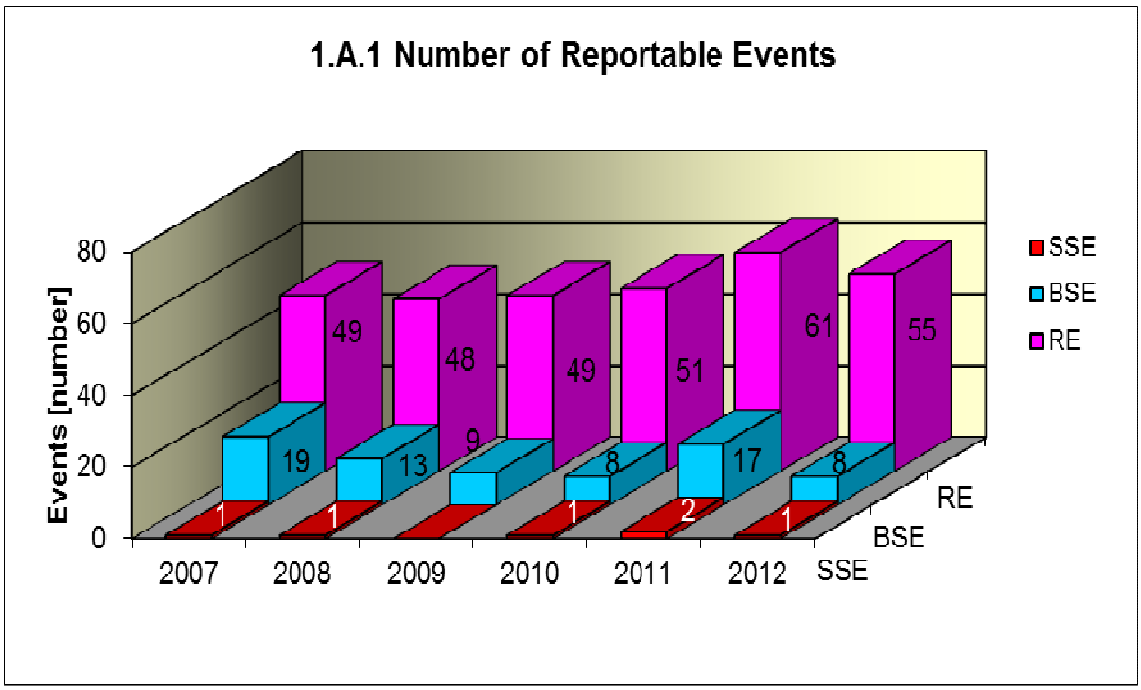
| | |
|---|---|
| **AŠP** | Activated and fission products |
| **AZ** | Reactor core |
| **BL** | Safety limit |
| **BS** | Safety system |
| **BSVP** | Spent fuel storage pool |
| **ČEZ** | Business name of the Czech utility - joint stock company ČEZ, a. s. |
| **DG** | Diesel generator |
| **E** | Individual effective dose |
| **EDU** | Dukovany nuclear power plant |
| **ETE** | Temelin nuclear power plant |
| **GO** | Overhaul |
| **HA** | Hydro-accumulator |
| **HMG** | Time schedule |
| **HP** | Hermetic premises |
| **HN PG** | Steam generator auxiliary feed-water system (Dukovany NPP) |
| **INES** | International Nuclear Event Scale |
| **JB** | Nuclear safety |
| **JE** | Nuclear power plant |
| **LIJB** | SÚJB local inspectors |
| **LS (a,b,c,d)** | Limitation system (various actuation functions) |
| **LaP (L&C)** | Limits and Conditions |
| **LPP** | Limiting condition for operation |
| **NT** | Low-pressure system |
| **NOS** | Protection system setting |
| **OKJZ** | Nuclear installation inspection section |
| **OROPC** | Fuel cycle radiation protection section |
| **OZIK** | Repetitive containment integrity test |
| **PG** | Steam generator |
| **PBU** | Safety indicator(s) |
| **PERIZ** | Periodic integral tightness testing |
| **PERZIK** | Periodic containment integrity test |
| **PRPS** | Primary reactor protection system |
| **RB** | Reactor unit |
| **RC** | Regional center |
| **REAZNII** | Automatics of emergency power system – category II |
| **ROR** | Reactor scram |
| **S** | Collective effective dose |
| **SAOZ (SHCHAZ)** | Emergency core cooling system |

| | |
|---|---|
| **SHN PG** | Steam generator emergency feed-water system (Dukovany NPP) |
| **SW** | Software |
| **SZB** | Safety assurance system |
| **TJ** | High-pressure emergency core cooling system |
| **TH** | Low-pressure emergency core cooling system |
| **TQ** | Dukovany NPP spray system / Temelin NPP emergency core cooling systems and spray system |
| **TX** | Emergency steam generator feedwater system (Temelin NPP) |
| **VT** | High-pressure system |
| **ZIK** | Structural over-pressure test |
| **ZKOB** | Safeguards and protection testing |

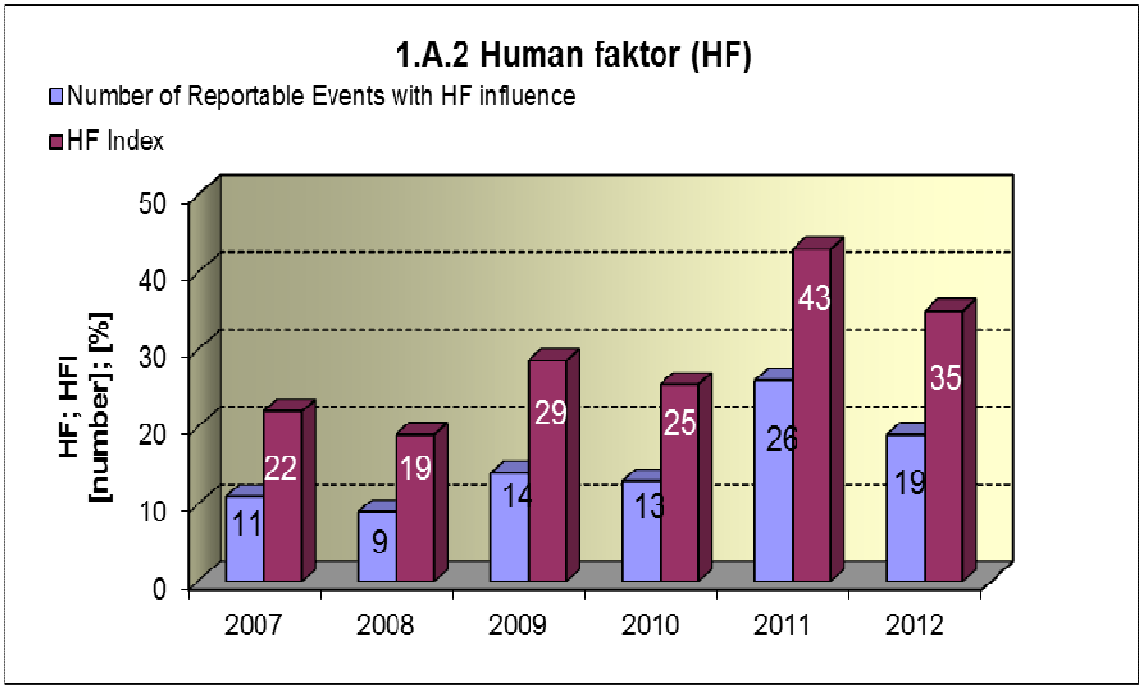
# 1. Significant Events

## 1.A Reportable events

Graph of indicator 1.A.1 monitors the development of number of reportable events (RE) including its division according to the evaluation of the International Nuclear Event Scale (INES) into significant events (SSE, INES > 0) and the below scale events (BSE, INES = 0).

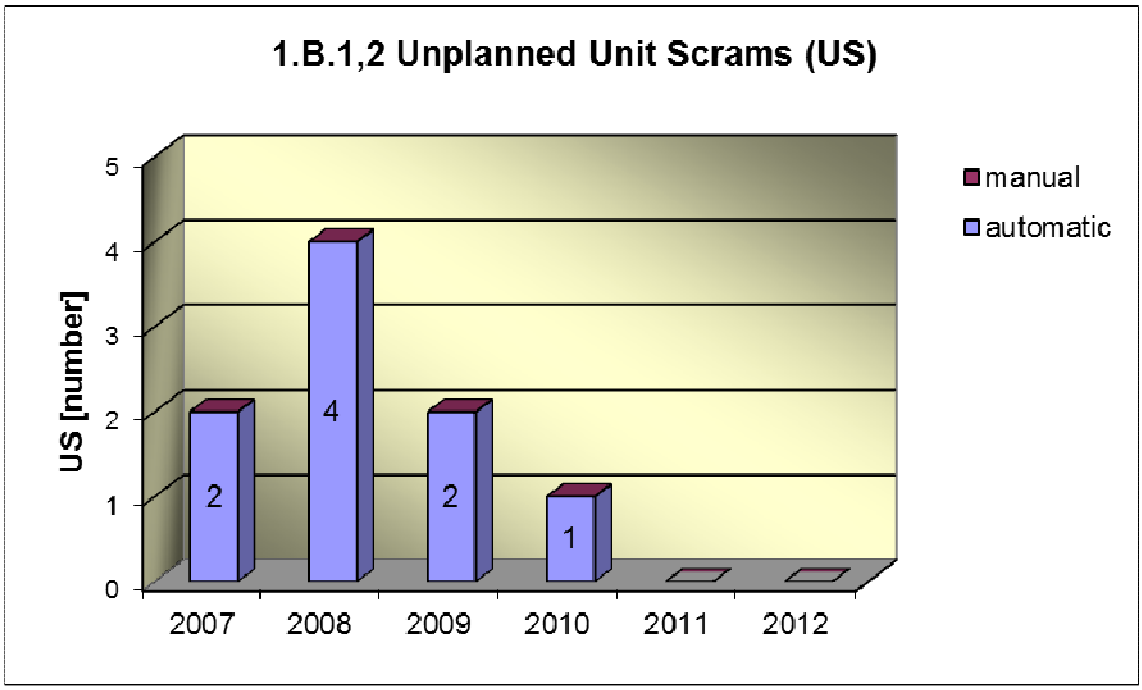



Graph 1.A.2 evaluates the influence of the human factor upon occurrence of reportable events. The indicator is expressed by the number of the reportable events with an influence of human factor (HF) and its percentage share (HFI).

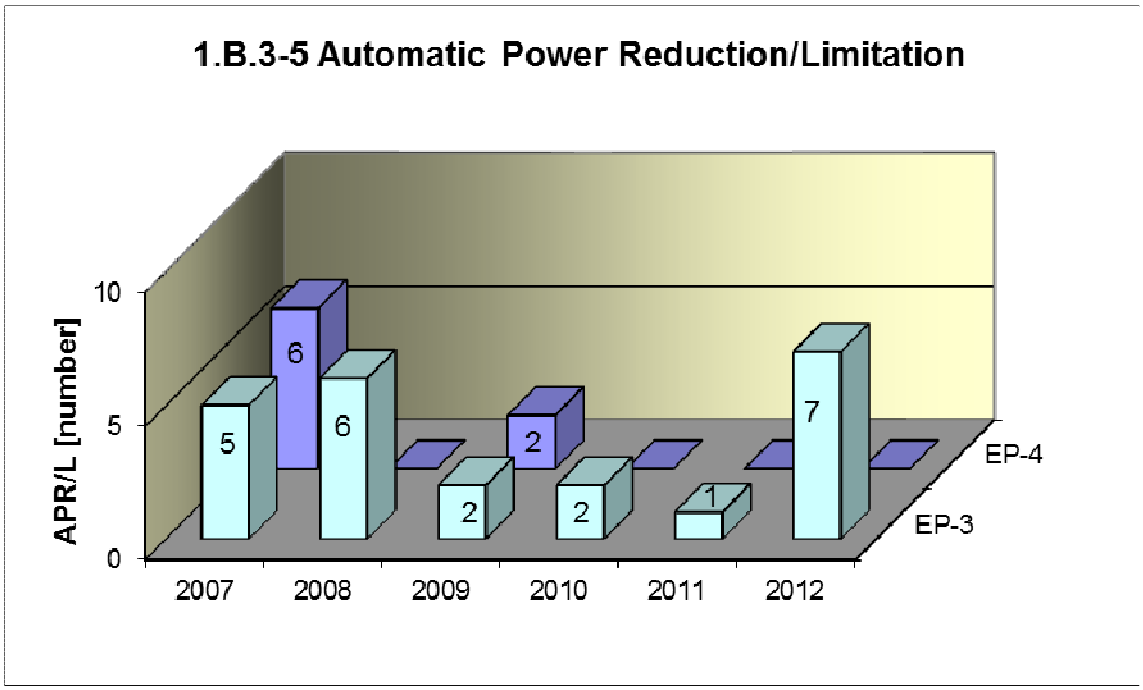


### 1.B Actuation of the protection and limitation systems

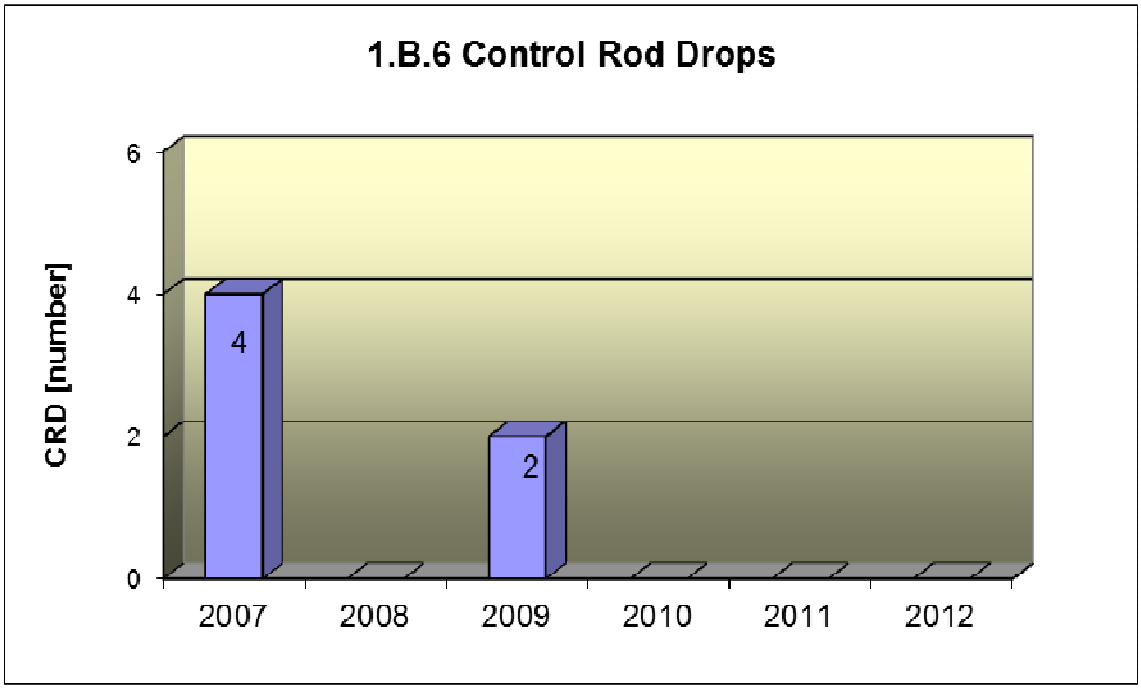
Graph 1.B.1,2 summarises the total number of unplanned unit scrams (US) (reactor in MODE 1 or 2) with resolution of manual and automatic shutdown. The term unplanned means that the scram was not an expected part of the planned test.




A common graph of indicators 1.B.3-5 presents the number of unplanned automatic power reduction (APR) by emergency protection of the 2nd – 4th type (HO-2, HO-3 a HO-4).

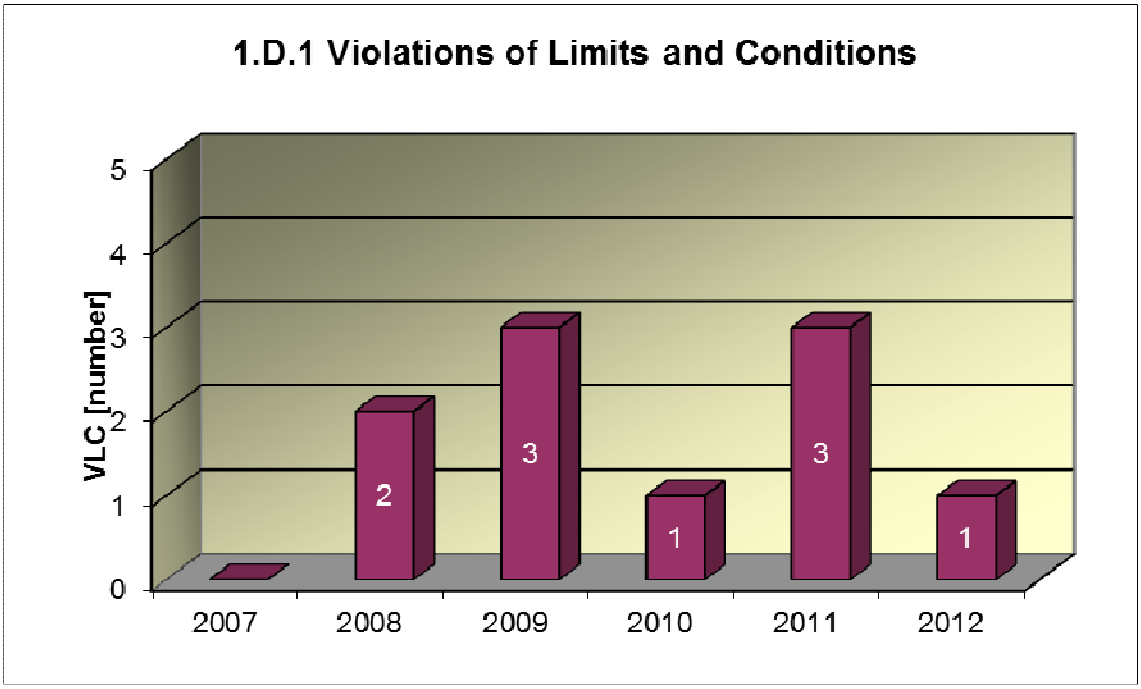


Graph 1.B.6 presents the development of the number of control rod drops (CRD).

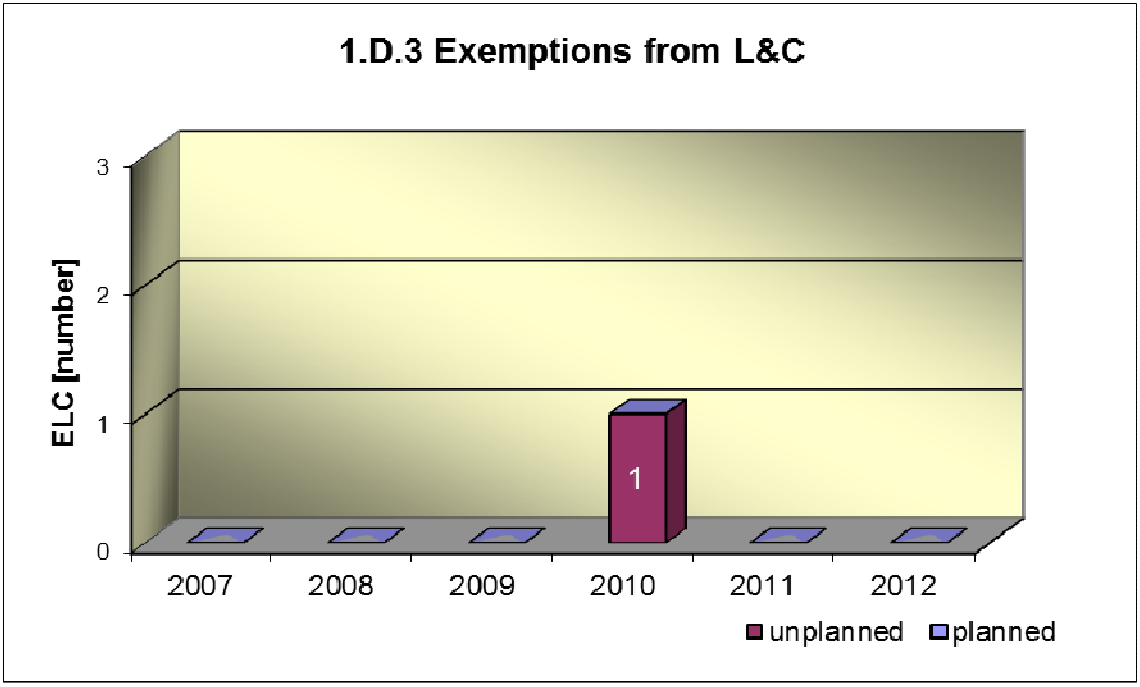


### 1.D Limits and Conditions

Graph 1.D.1 summarises violations of the Limits and Conditions (VLC) detected by the Regulatory body or reported to the Regulatory body by the licensee.




Graph 1.D.3 summarises the number of planned and unplanned exemptions from the Limits and Conditions (ELC) approved by the Regulatory body including those requiring SUJB approval and however not drawn for various reasons.



# 2. Safety Systems Performance

Area 2 monitors and evaluates availability of the following safety systems (BS) in group A:

| | |
|---|---|
| - diesel generators | **DG** |
| - high pressure emergency core cooling system | **TJ** |
| - low pressure emergency core cooling system | **TH** |
| - spray system | **TQ** |
| - hydro-accumulators | **HA** |
| - steam generator auxiliary feed-water system | **HN PG** |
| - steam generator emergency feed-water system | **SHN PG** |

and in group B failure of diesel generator (DG), high pressure emergency core cooling system (TJ), low pressure emergency core cooling system (TH) and spray system (TQ) in starting and operation.

## 2.A Safety system unavailability

Unavailability of particular safety systems ($SSU_S$) - graphs 2.A.1.a – g, is defined as the ratio of the total time of unavailability of an evaluated safety system to the total time when its availability was required. In addition, these combined graphs express the ratio of unavailability of respective safety system to the "general" safety system of the site.

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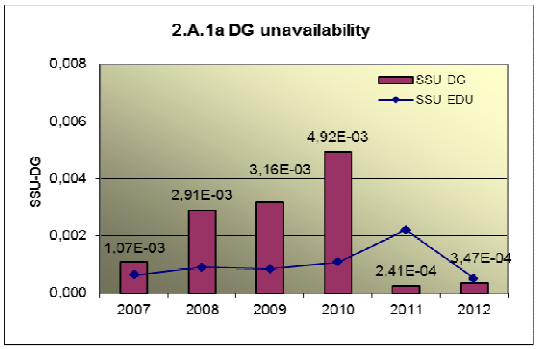
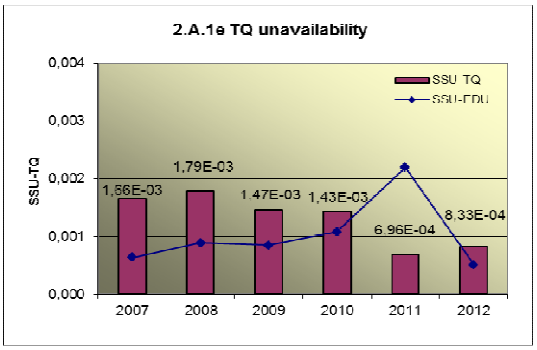
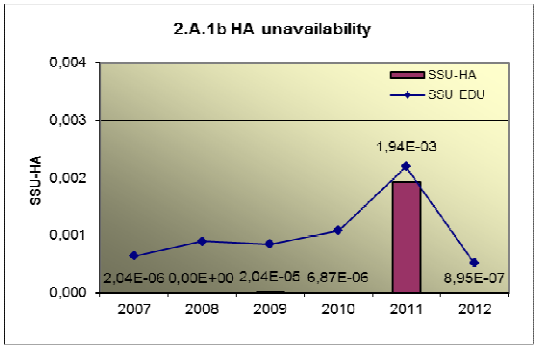
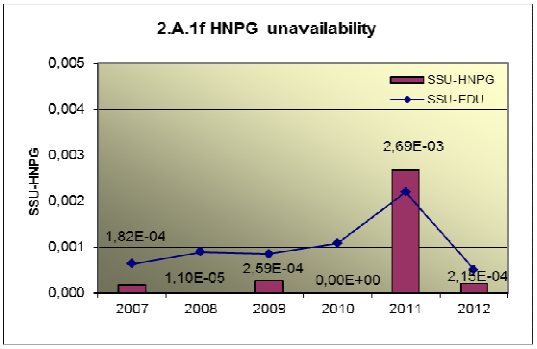
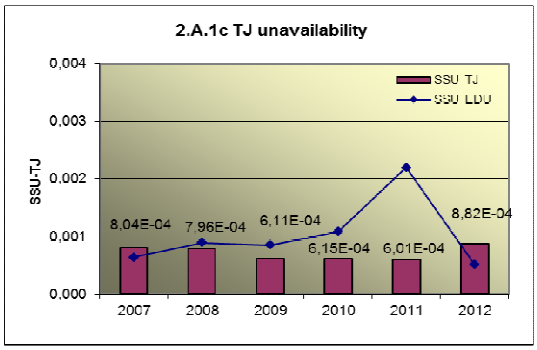
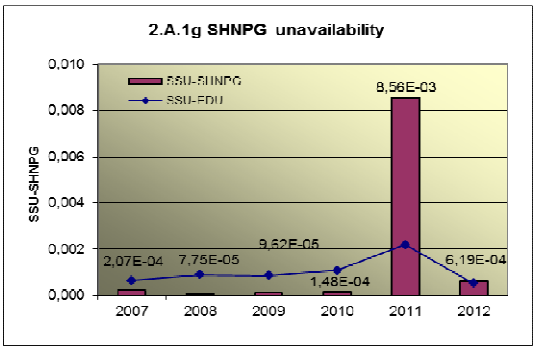


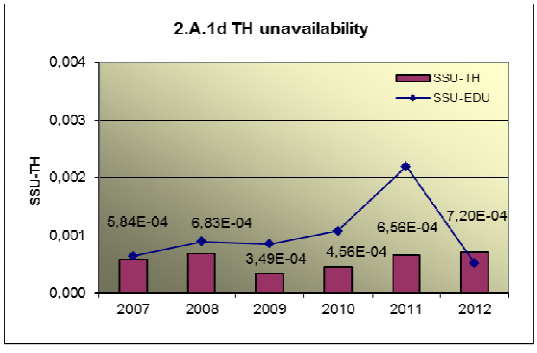



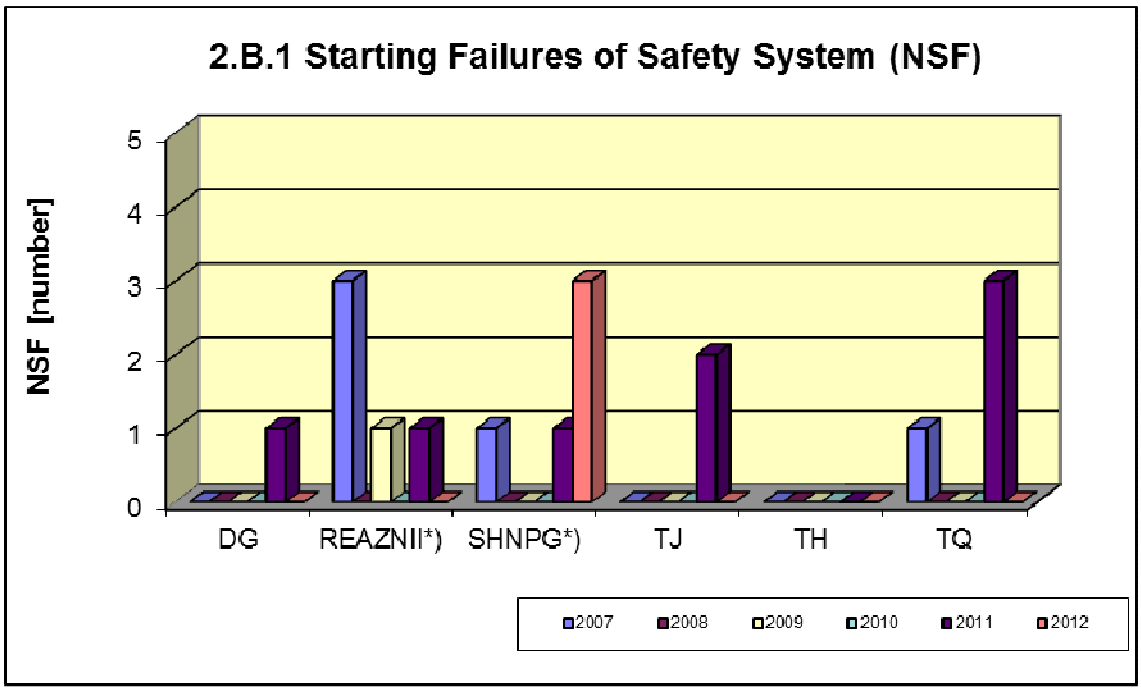



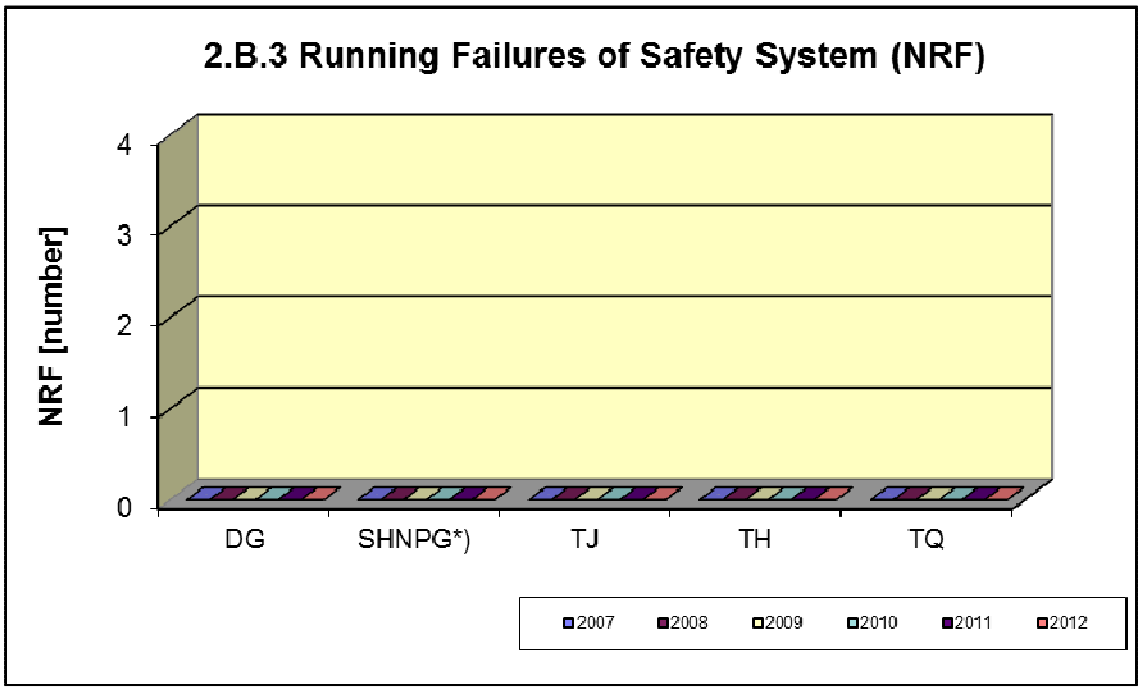



### 2.B.1 Failure of safety systems

Graph 2.B.1 indicates the number of starting failures of the safety system (NSF), i.e. the state when the respective system, possibly set after the command to start, does not achieve nominal performance characteristic or its failure (shutdown) occurs within 30 minutes after its start.



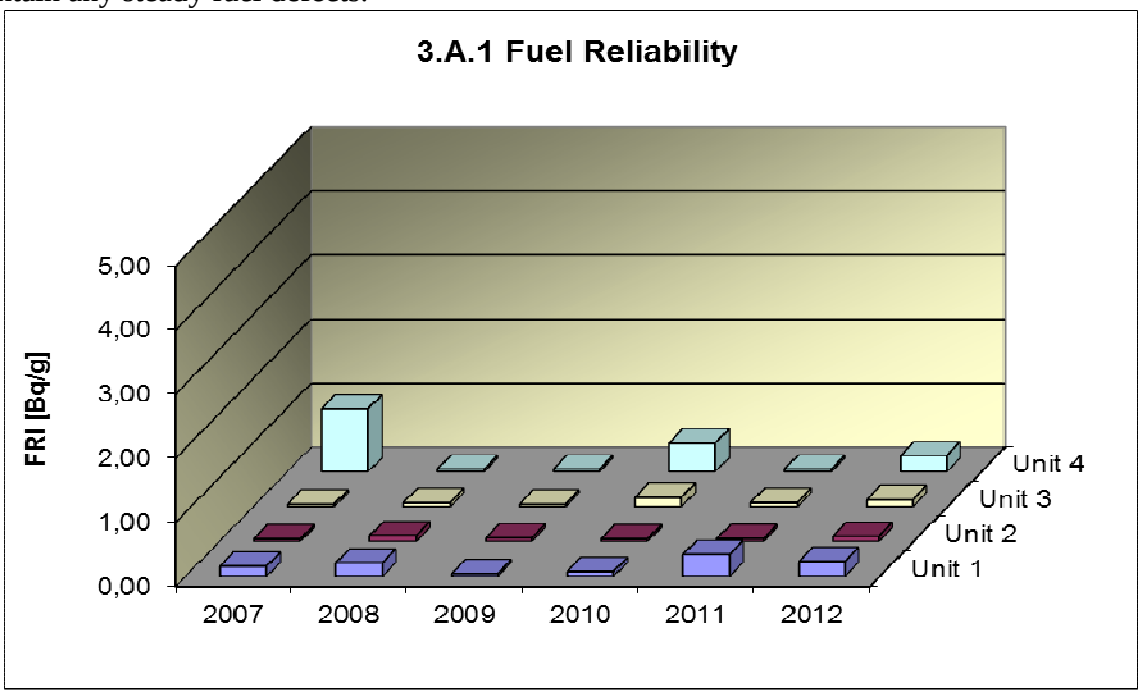

Graph 2.B.3 indicates the number of running failures of safety system (NRF), i.e. the number of states when failure shut down of respective system, drive, possibly set occurs at nominal performance characteristics for the time exceeding 30 minutes since its starting.



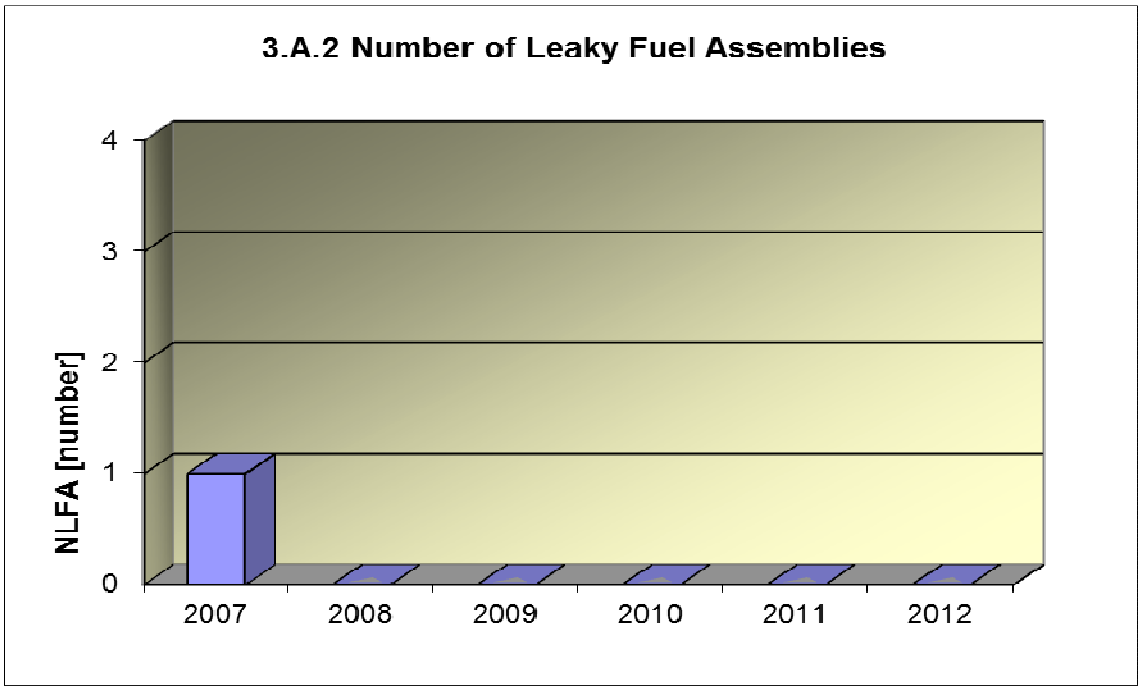
# 3. Barriers Integrity

**3.A Nuclear fuel**

Graph 3.A.1 monitors fuel reliability of particular units through the values of FRI - Fuel reliability index. The value FRI ≤ 19Bq/g expresses that reactor core most likely does not contain any steady fuel defects.

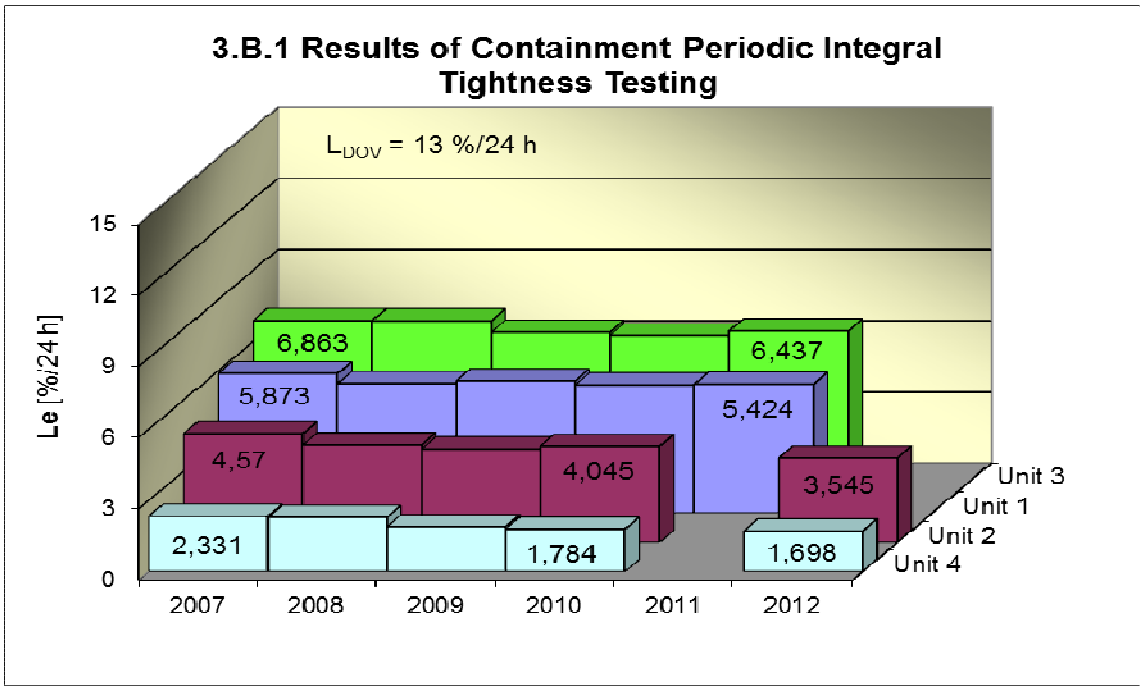



Graph 3.A.2 indicates the number of leaky fuel assemblies (NLFA) that had to be put out of operation due to their inadmissible leakage.



### 3.B Containment

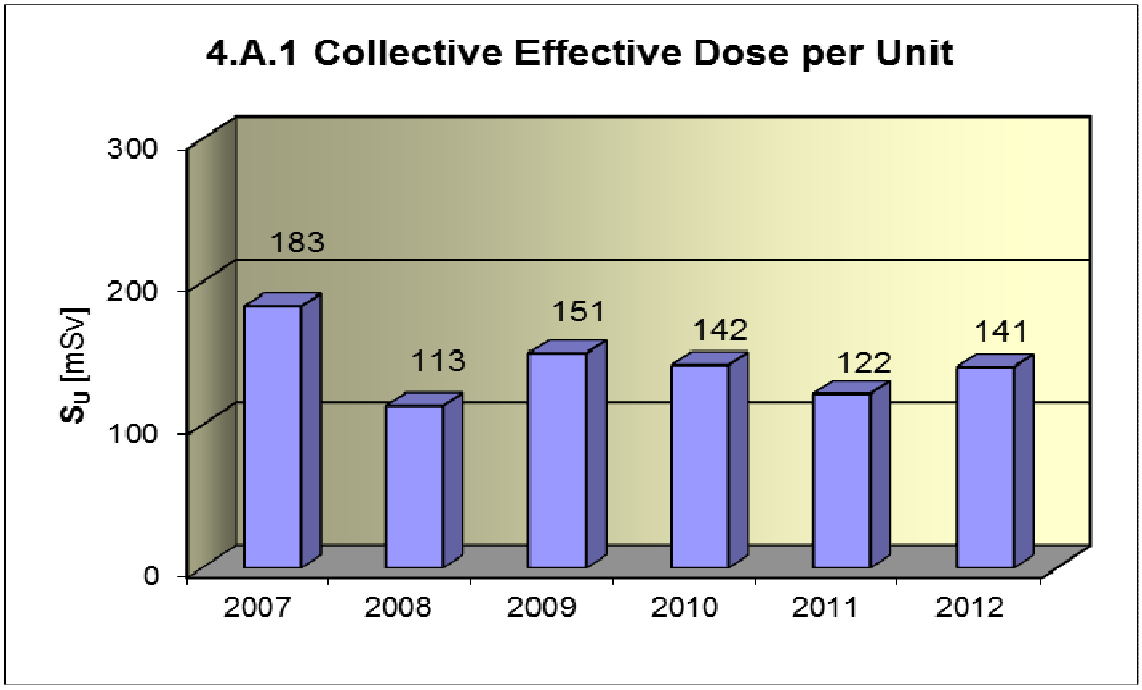
Graph 3.B.1 states the results of Containment periodic integral tightness testing ($L_e$), i.e. the results of leakage tests of hermetic areas executed by overpressure 150 kPa lasting 24 hours. Extrapolated results are included for the tests with a lower pressure and dwell.



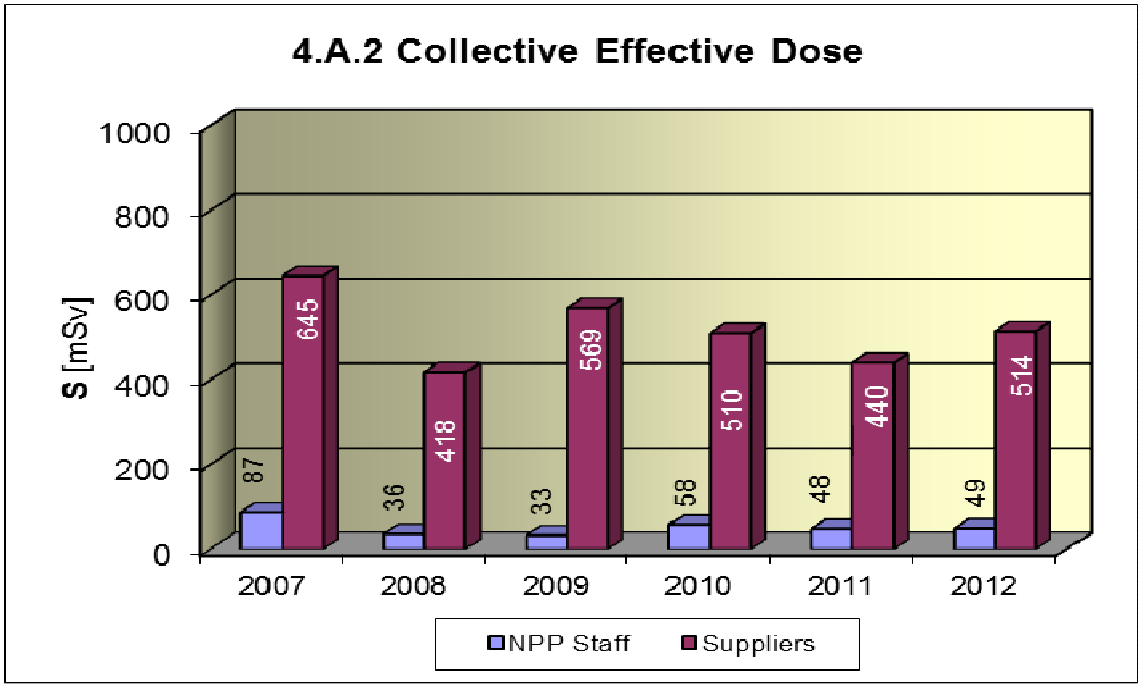
# 4. Radiation Protection

## 4.A Staff

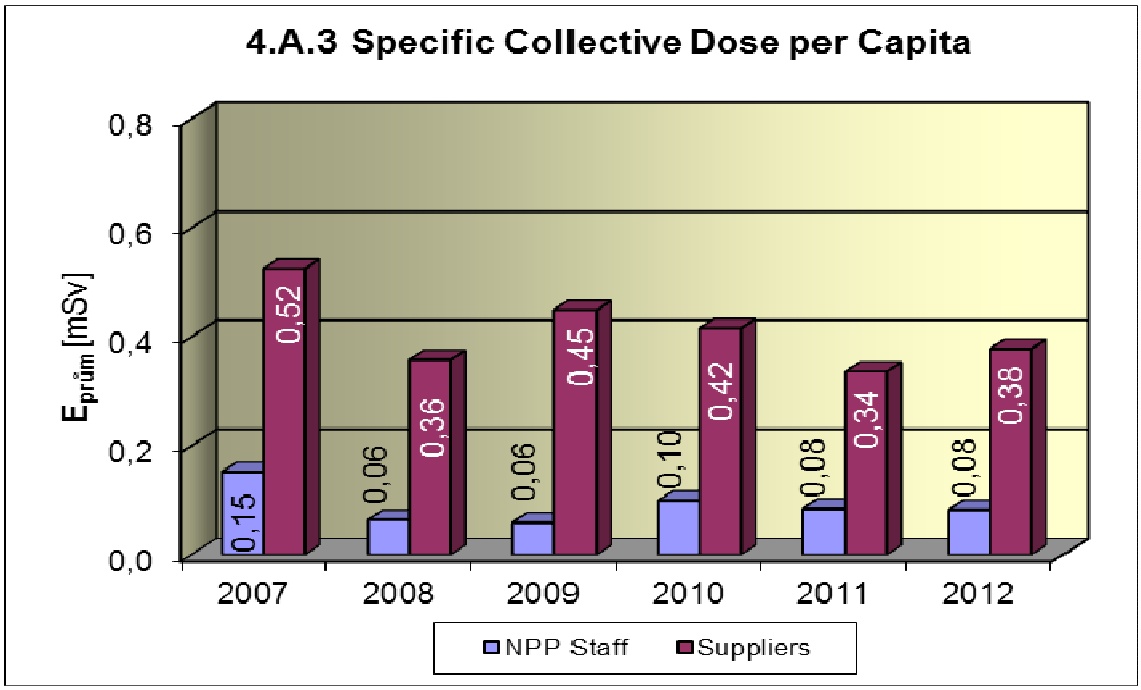
Graph 4.A.1 indicates collective effective dose (CED) received by the staff of NPP (including suppliers and visitors) during monitored period, measured by basic film dosimeters and expressed by mean value per unit.



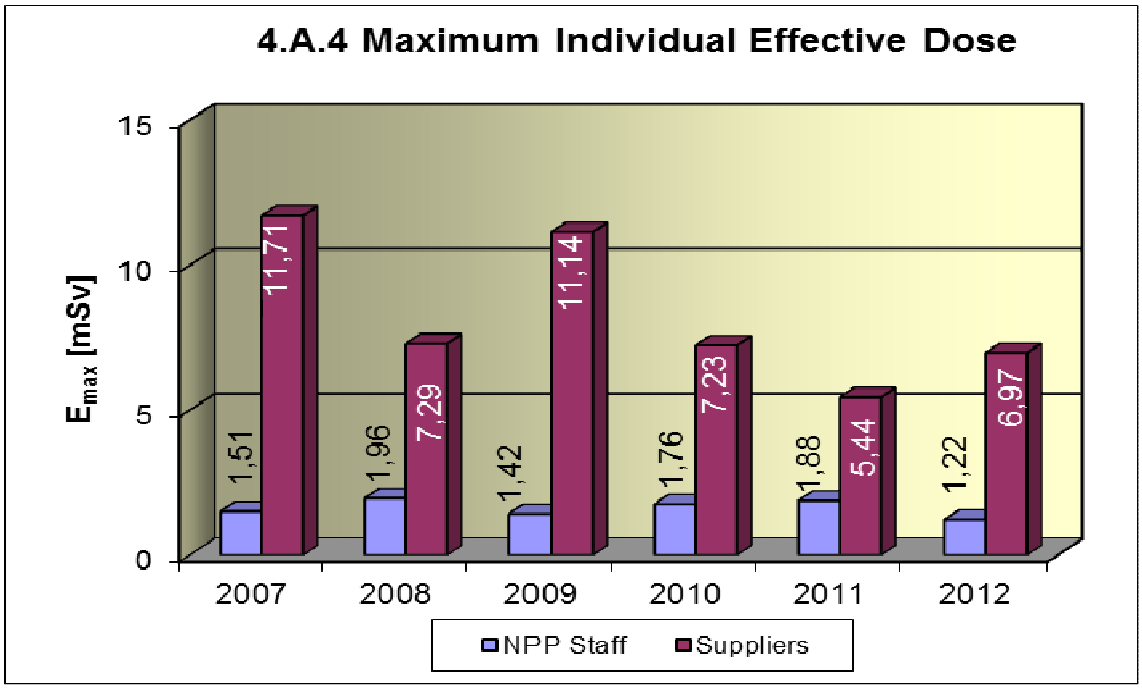

Graph 4.A.2 indicates collective effective dose received by the staff of NPP and suppliers during monitored period, measured by basic film dosimeters.



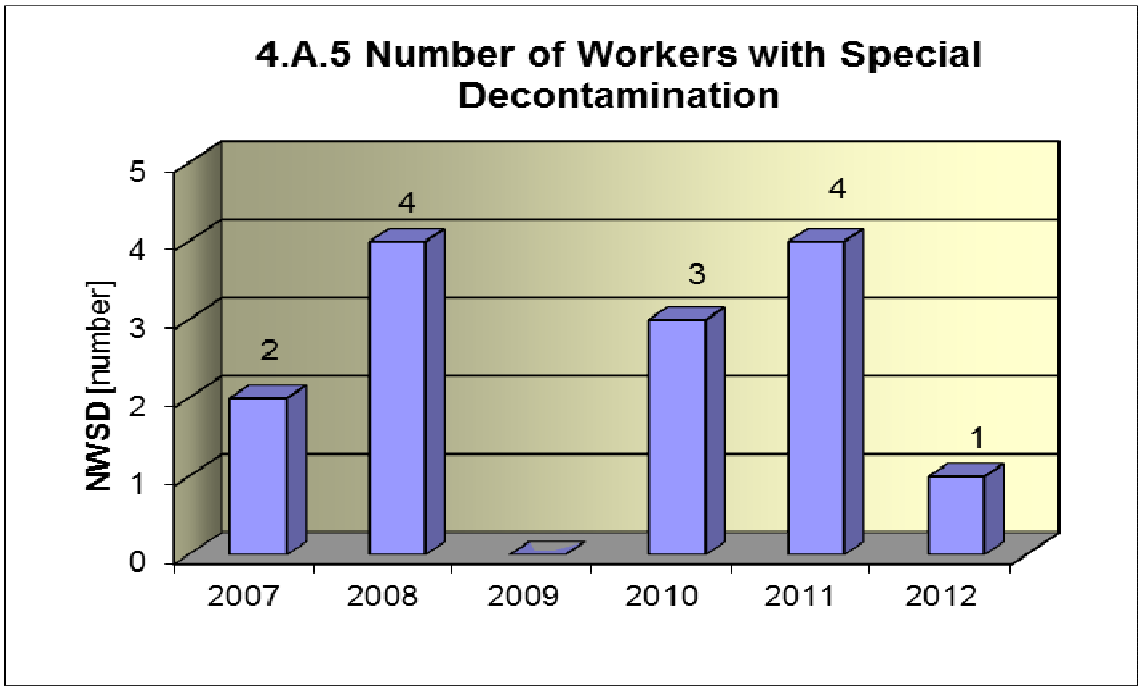
Graph 4.A.3 indicates specific collective effective dose received by the staff of NPP and suppliers during monitored period, measured by basic film dosimeters and express by value per one radiation worker.




Graph 4.A.4 indicates maximum individual effective dose received by one particular employee of NPP and one particular employee of supplier during monitored period, measured by basic film dosimeters.

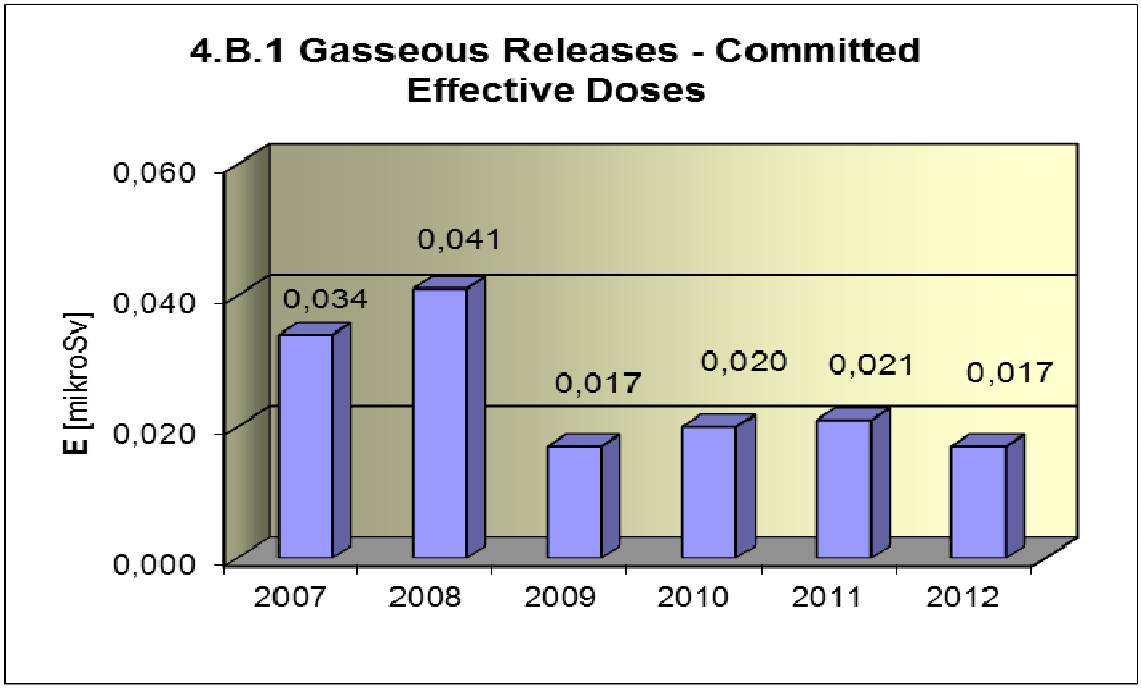


Graph 4.A.5 indicates number of workers (NPP and suppliers) subjected to a special decontamination under medical supervision.

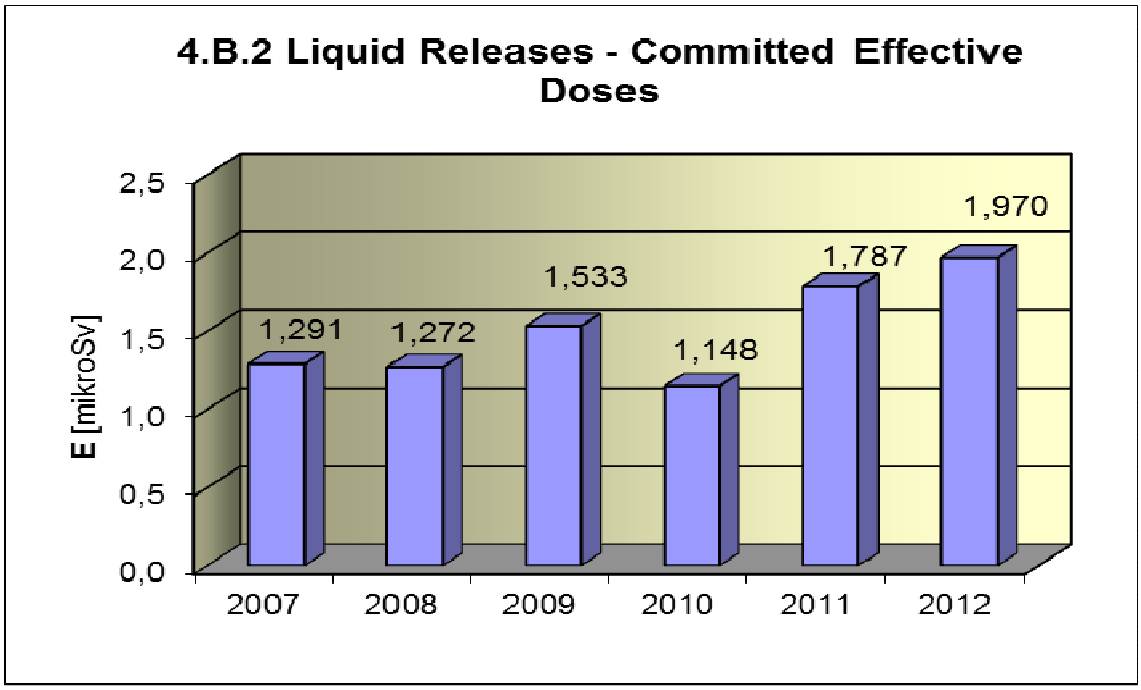


**4.B Radioactive Releases**

Graph 4.B.1 indicates the committed effective dose for an individual, which arises from radioactive gaseous releases from NPP.



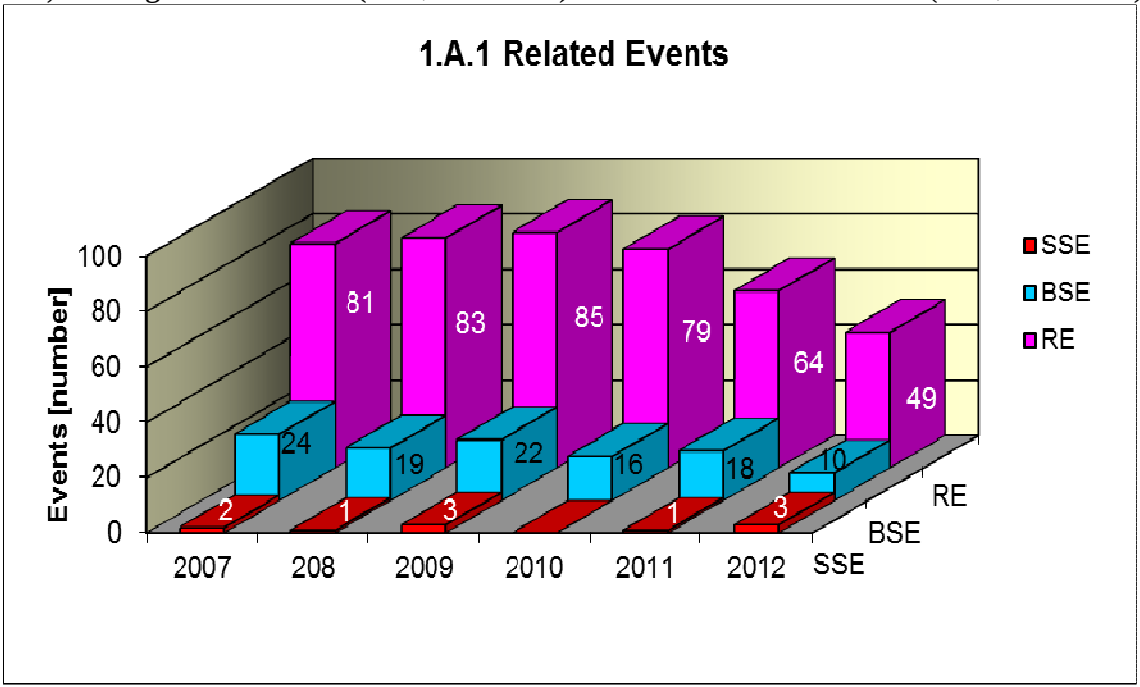

Graph 4.B.2 indicates the committed effective dose for an individual, which arises from radioactive liquid releases from NPP.



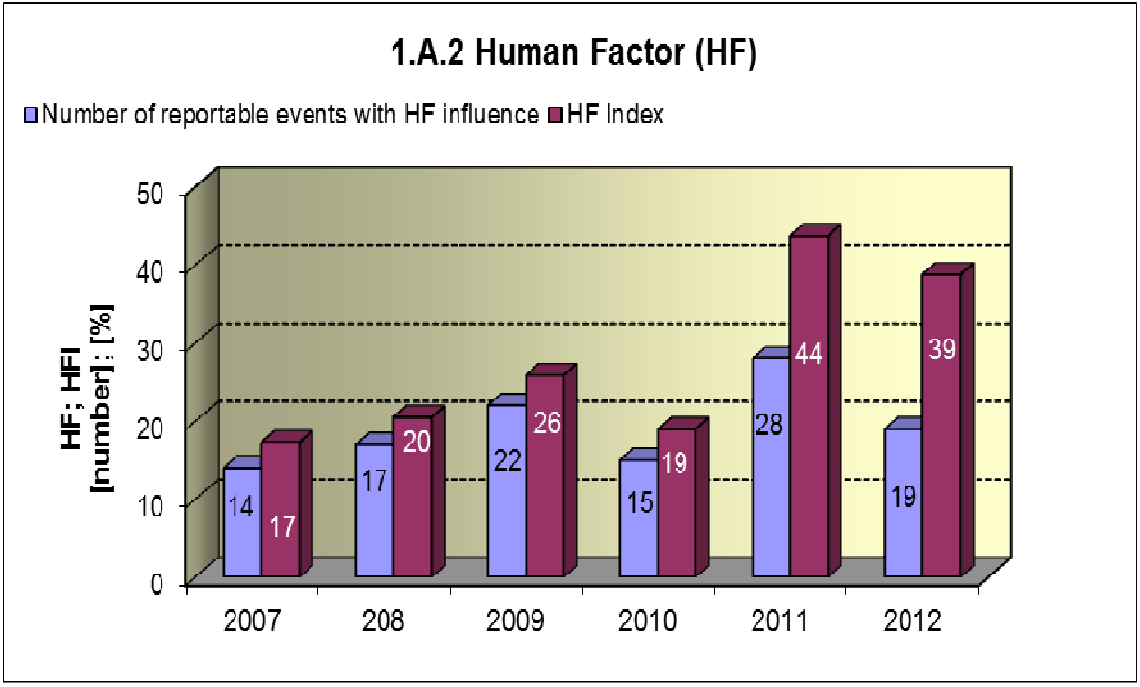
# 1. Significant Events

## 1.A Related events

Graph of indicator 1.A.1 monitors the development of the number of related events (RE) including their division according to the evaluation of the International Nuclear Event Scale (INES) into significant events (SSE, INES > 0) and the below scale events (BSE, INES = 0).

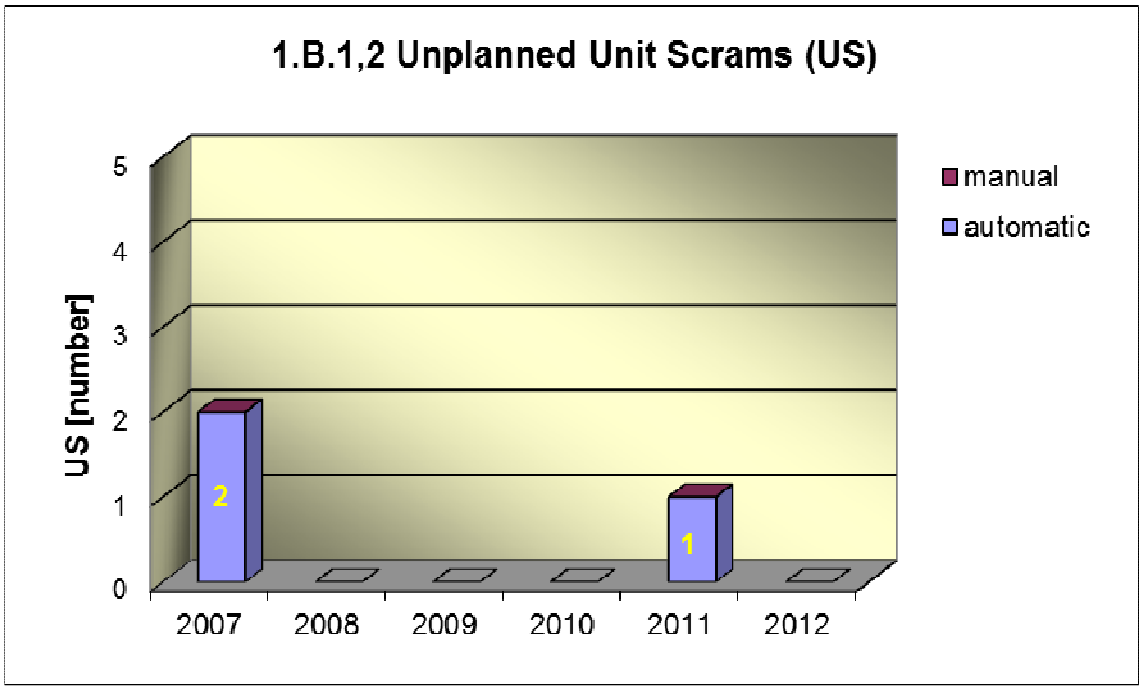



Graph 1.A.2 evaluates the influence of the human factor upon occurrence of safety related events. The indicator is expressed by the number of the safety-related events with an influence of human factor (HF) and its percentage share (HFI).

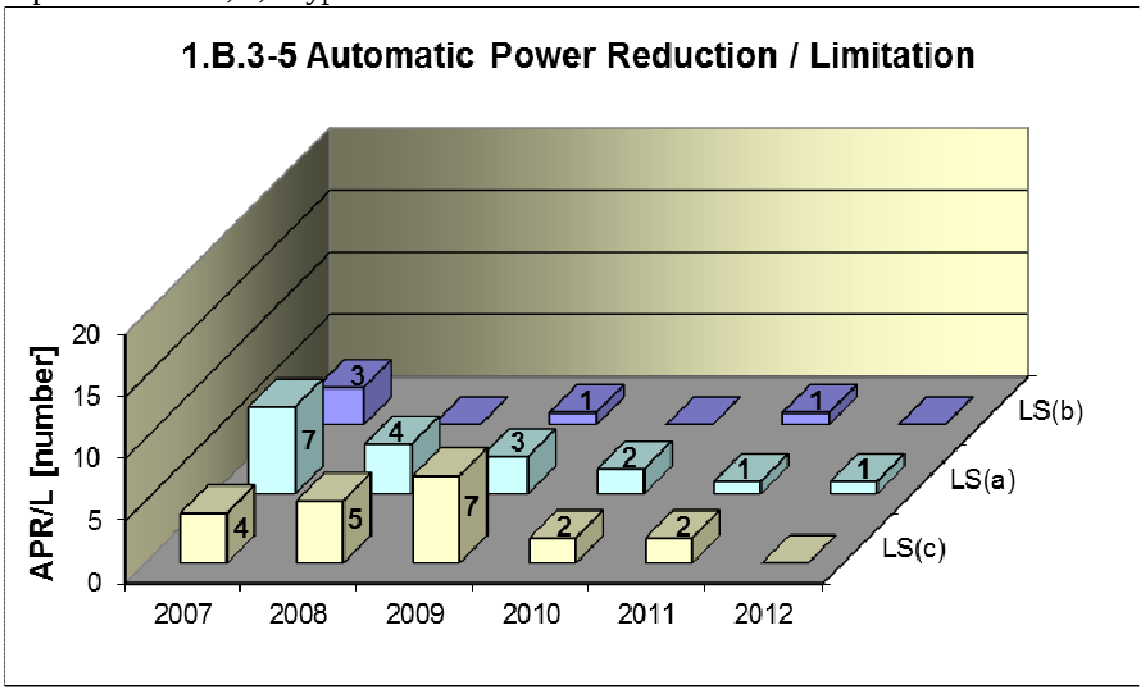


### 1.B Actuation of the protection and limitation systems

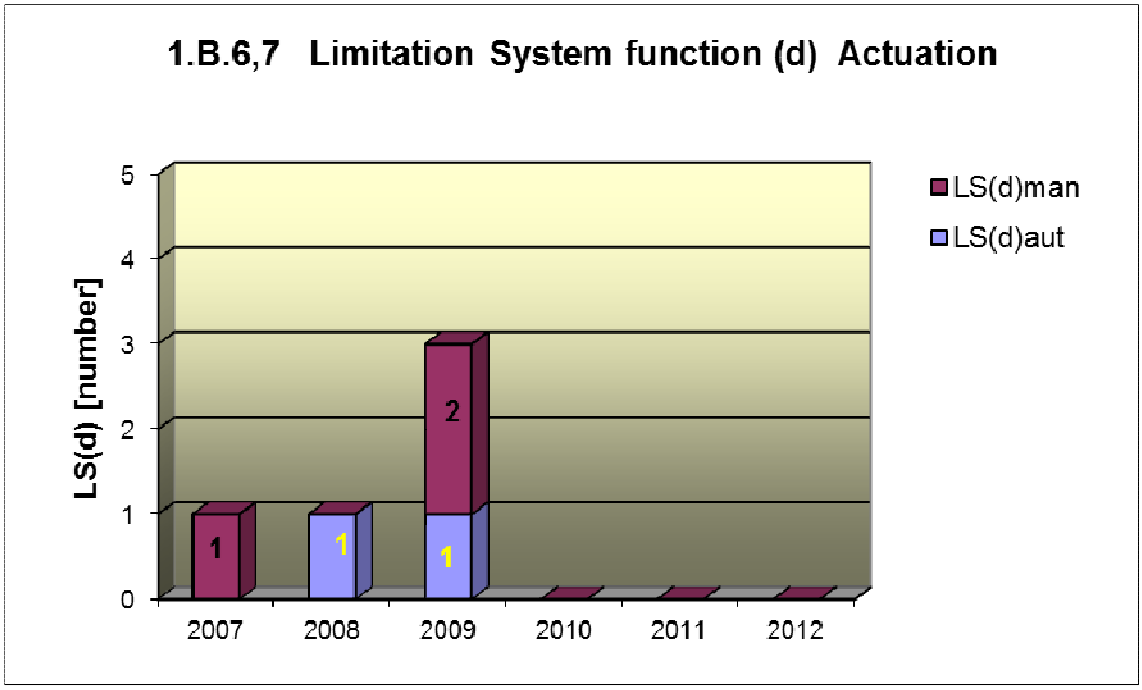
Graph 1.B.1,2 summarises the total number of unplanned unit scrams (US) (reactor in MODE 1 or 2) with resolution of manual and automatic shutdown. The term "unplanned" means that the scram was not an expected part of the planned test.




A common graph of indicators 1.B.3-5 indicates the number of limitation system (LS) incorporation with a, b, c types.

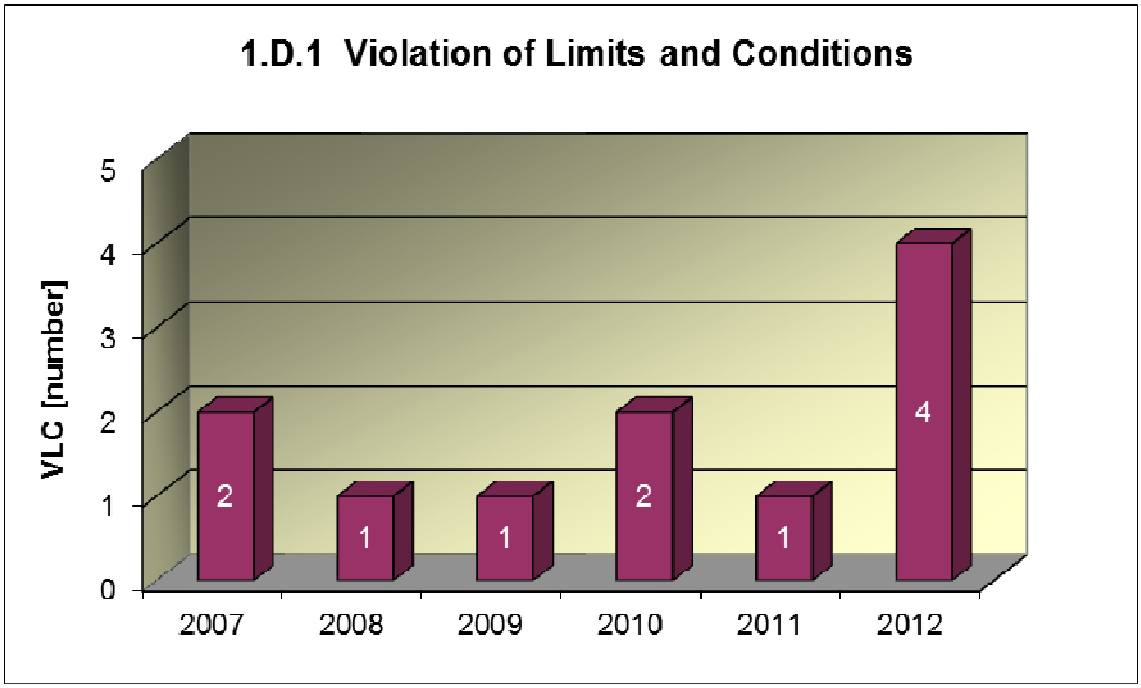


Graph 1.B.6,7 summarises the total number of unplanned reactor scrams with action of the limitation system (LS(d)) (reactor in MODE 1 or 2) with resolution of manual and automatic shutdown. The term "unplanned" means that the scram was not an expected part of the planned test.

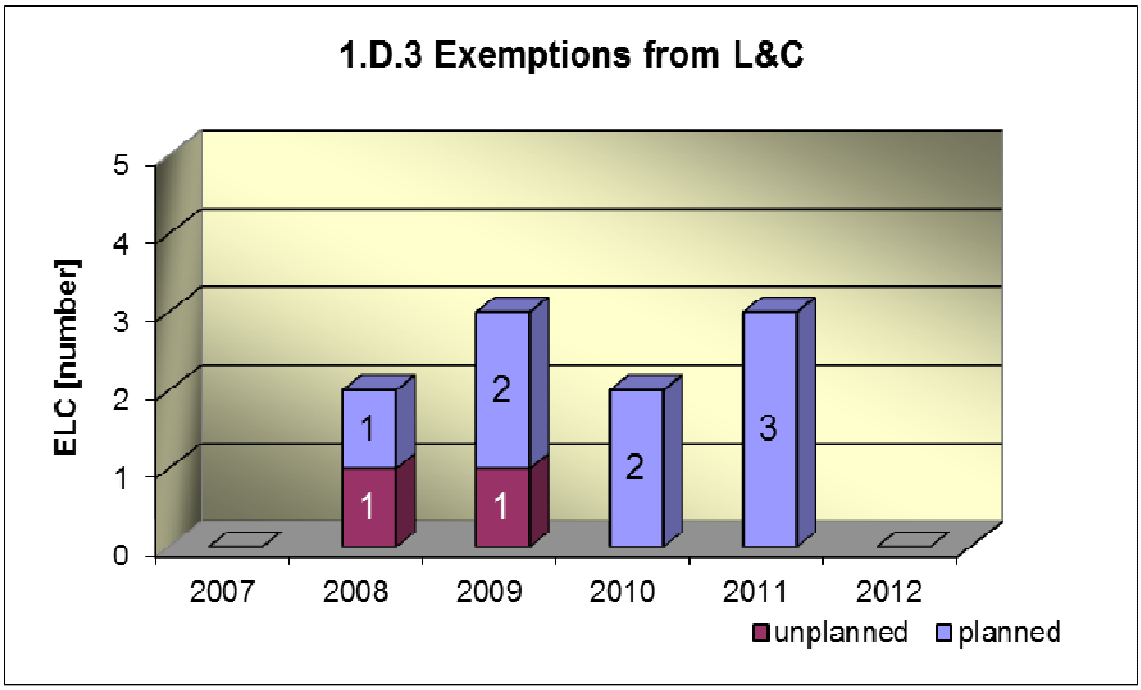


### 1.D Limits and Conditions

Graph 1.D.1 summarises violations of the Limits and Conditions (VLC) detected by the Regulatory body or reported to the Regulatory body by the licensee.




Graph 1.D.3 summarises the number of planned and unplanned exemptions from the Limits and Conditions (ELC) approved by the Regulatory body including those requiring SUJB approval and however not drawn for various reasons.



# 2. Safety Systems Performance

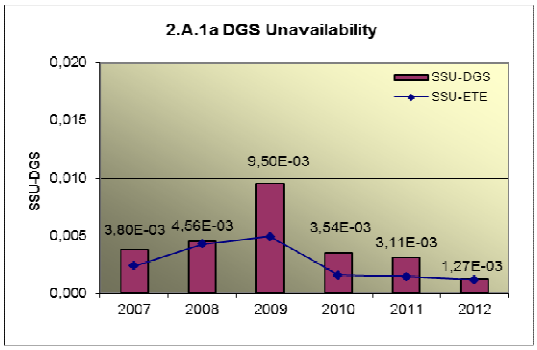
Area 2 monitors and evaluates availability of the following safety systems (BS) in group A:

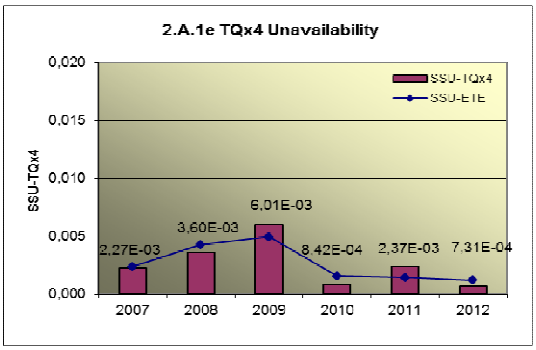
| | |
|---|---|
| - system diesel generators | **DGS** |
| - spray system | **TQx1** |
| - low pressure emergency core cooling system | **TQx2** |
| - high pressure emergency core cooling system | **TQx3** |
| - boric acid emergency injection system | **TQx4** |
| - hydro-accumulators | **HA** |
| - steam generator emergency feed-water system | **TX** |

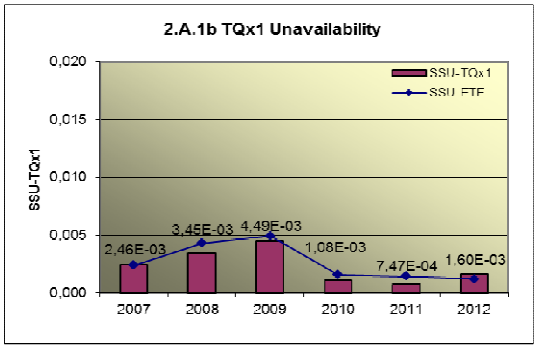
and in group B failure of diesel generator (DG), spray system (TQx1), low pressure emergency core cooling system (TQx2), high pressure emergency core cooling system (TQx3), boric acid emergency injection system (TQx4) in starting and operation.

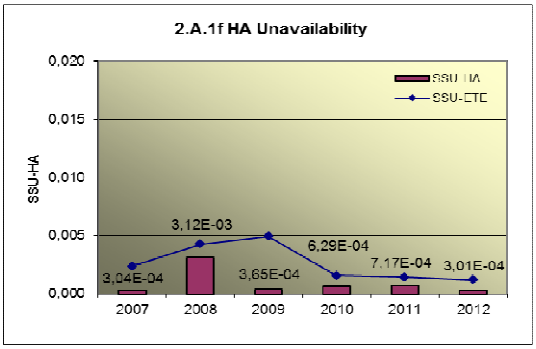
## 2.A Safety system unavailability

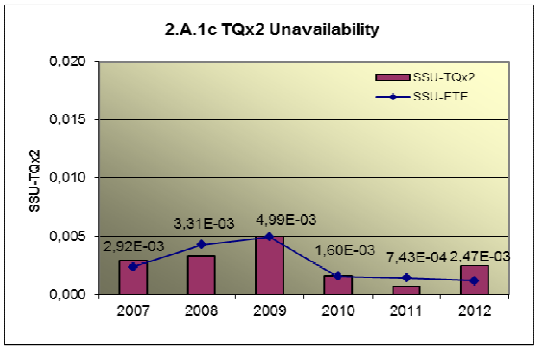
Unavailability of particular safety systems ($SSU_S$) - graphs 2.A.1.a – g, is defined as the ratio of the total time of unavailability of an evaluated safety system to the total time when its availability was required. In addition, these combined graphs express the ratio of unavailability of respective safety system to the "general" safety system of the site.

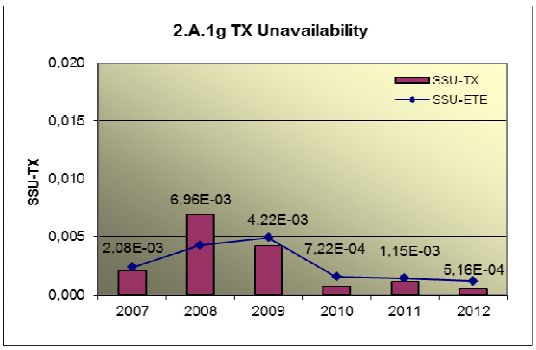


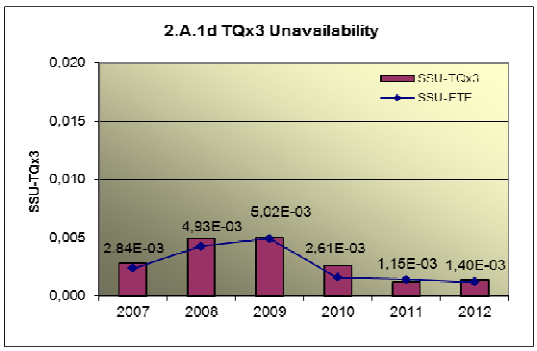



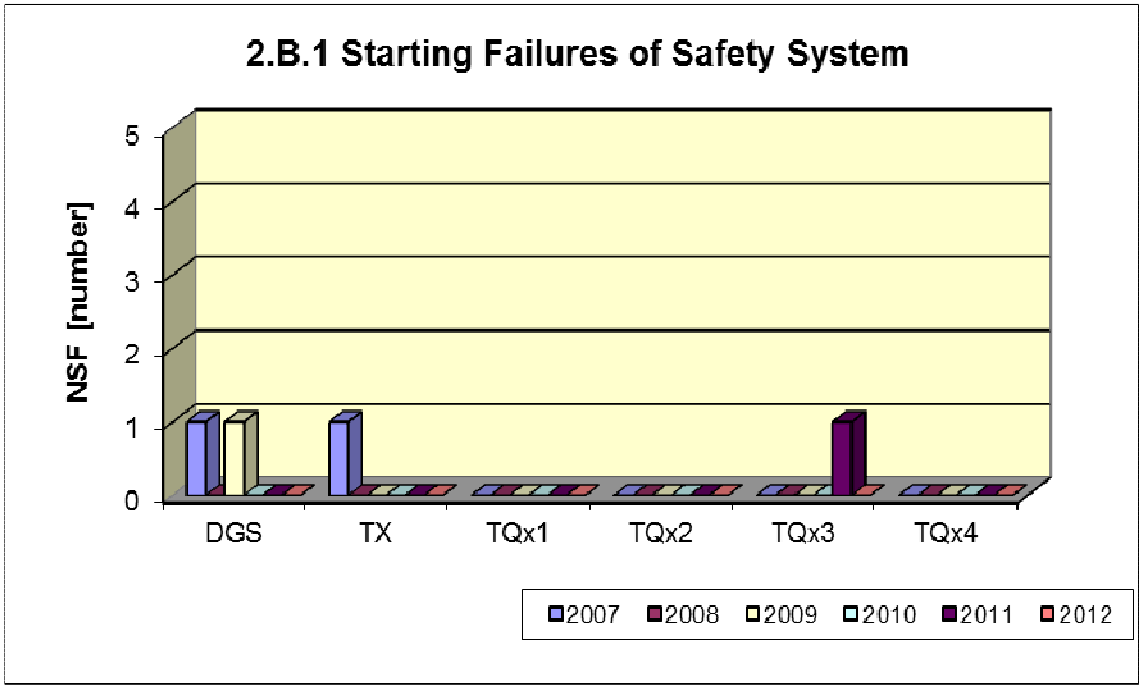



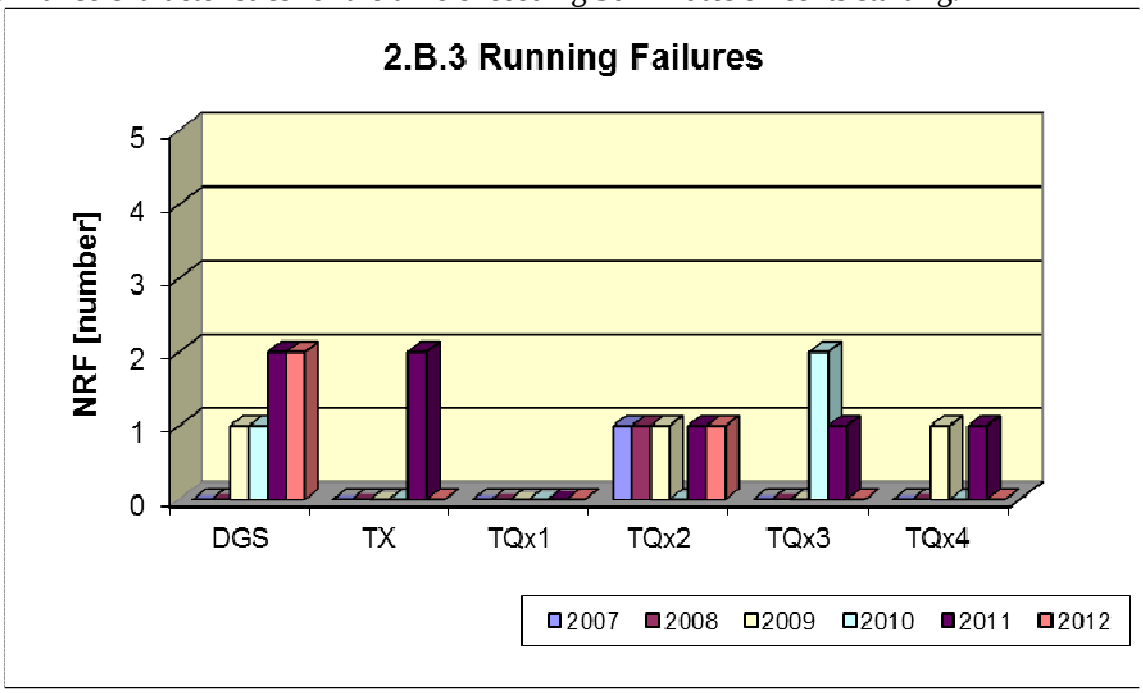



**2.B Failure of safety systems**

Graph 2.B.1 indicates the number of starting failures of the safety system (NSF), i.e. the state when the respective system, possibly set after the command to start, does not achieve nominal performance characteristic or its failure (shutdown) occurs within 30 minutes after its start.



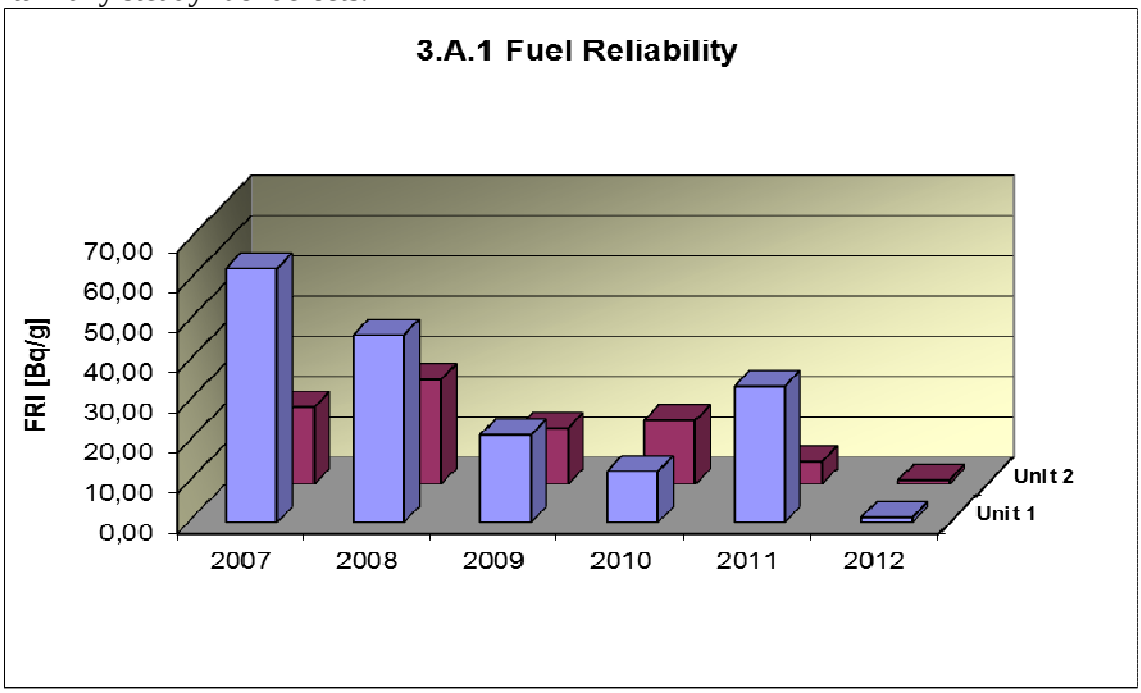

Graph 2.B.3 indicates the number of running failures of safety system (NRF), i.e. the number of states when failure shut down of respective system, drive, possibly set occurs at nominal performance characteristics for the time exceeding 30 minutes since its starting.



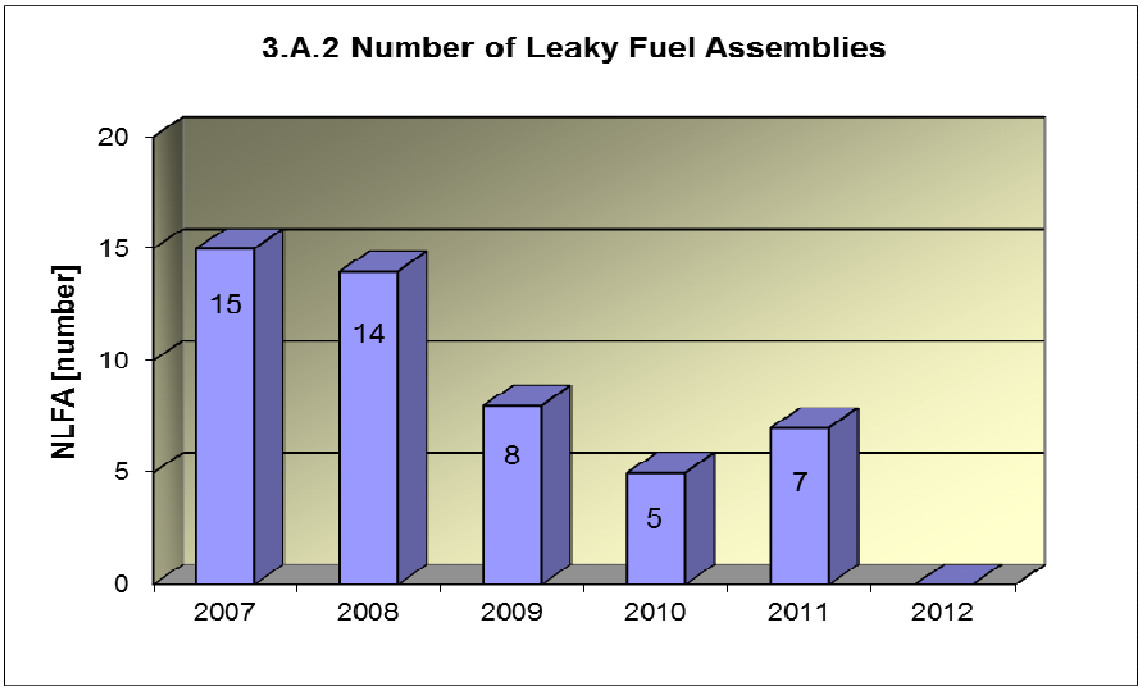
# 3. Barriers integrity

## 3.A Nuclear fuel

Graph 3.A.1 monitors fuel reliability of particular units through the values of FRI - Fuel reliability index. The value FRI ≤ 19Bq/g expresses that reactor core most likely does not contain any steady fuel defects.

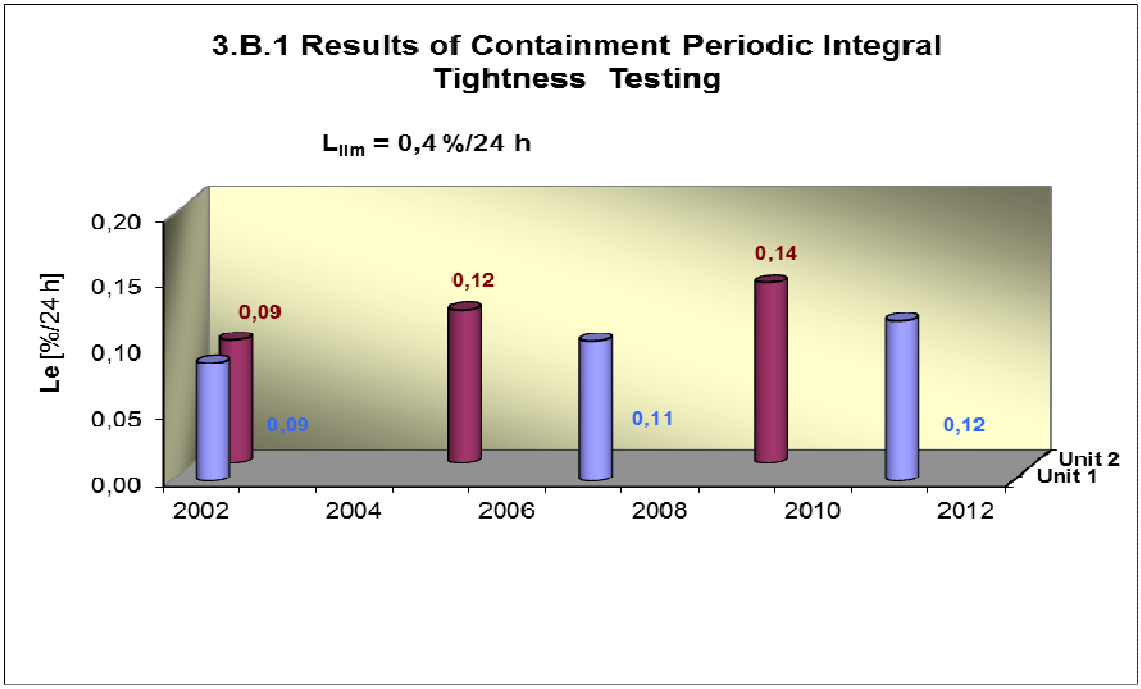



Graph 3.A.2 indicates the number of leaky fuel assemblies (NLFA) that had to be put out of operation due to their inadmissible leakage.



## 3.B Containment

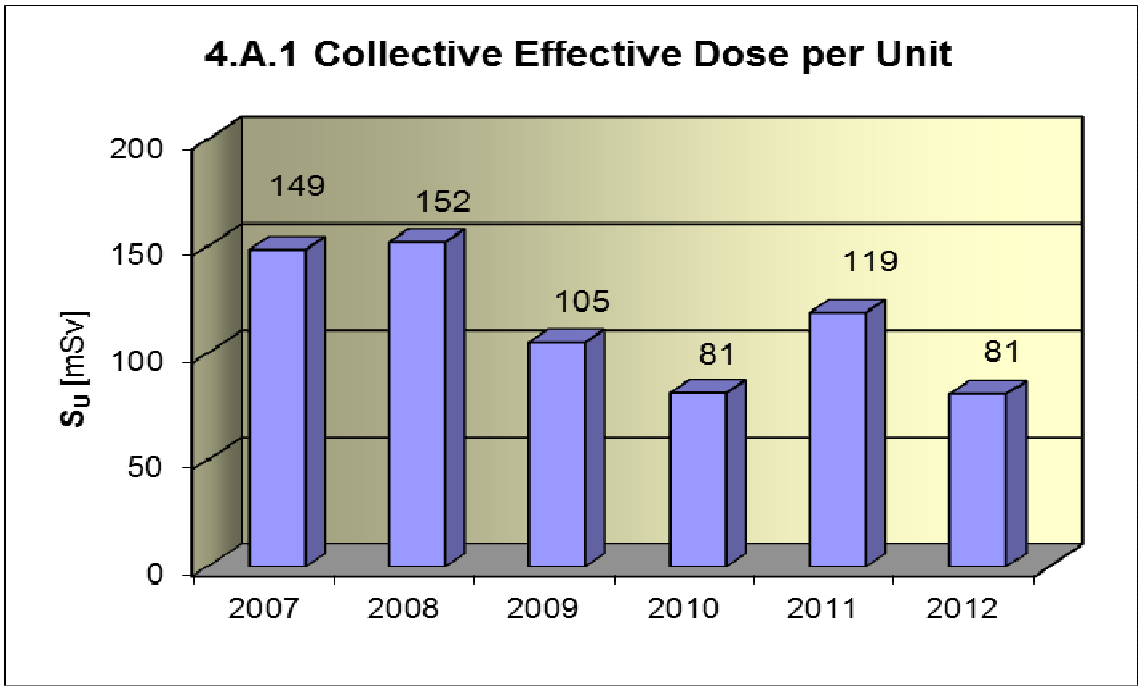
Graph 3.B.1 states the results of Containment periodic integral tightness testing ($L_e$), i.e. the results of leakage tests of hermetic areas executed by overpressure 400 kPa lasting 24 hours during Containment integrity testing and extrapolated results are stated for Containment integrity repeated testing and Containment integrity periodic testing with lower pressure of 70 kPa and dwell.



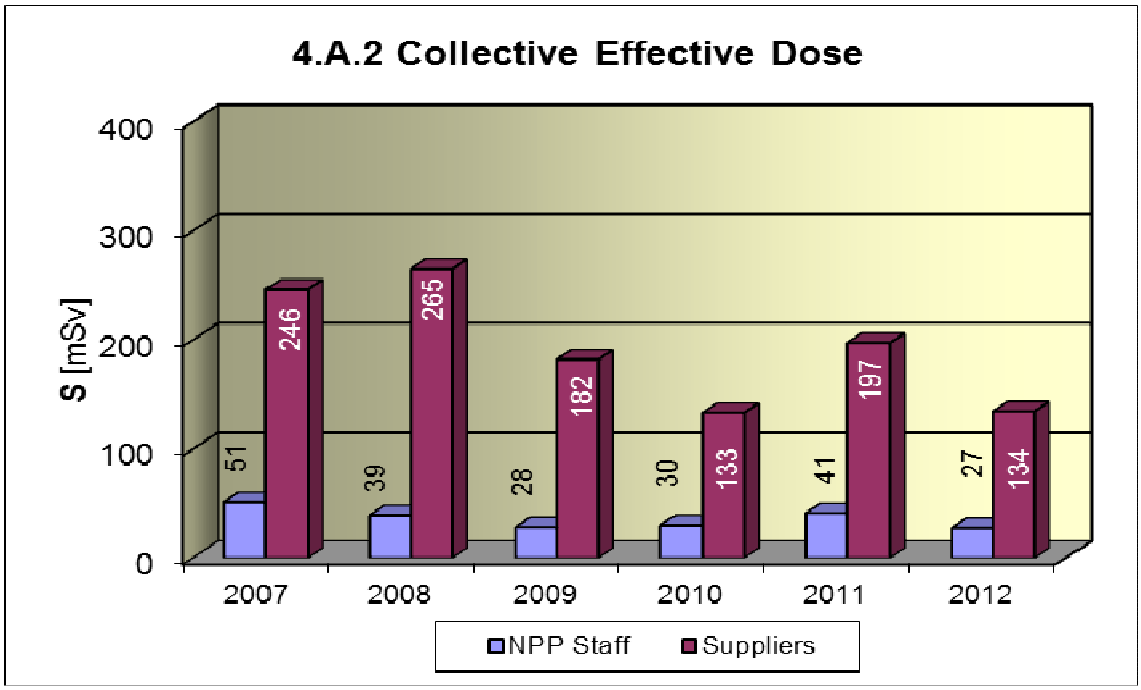
# 4. Radiation Protection

## 4.A Staff

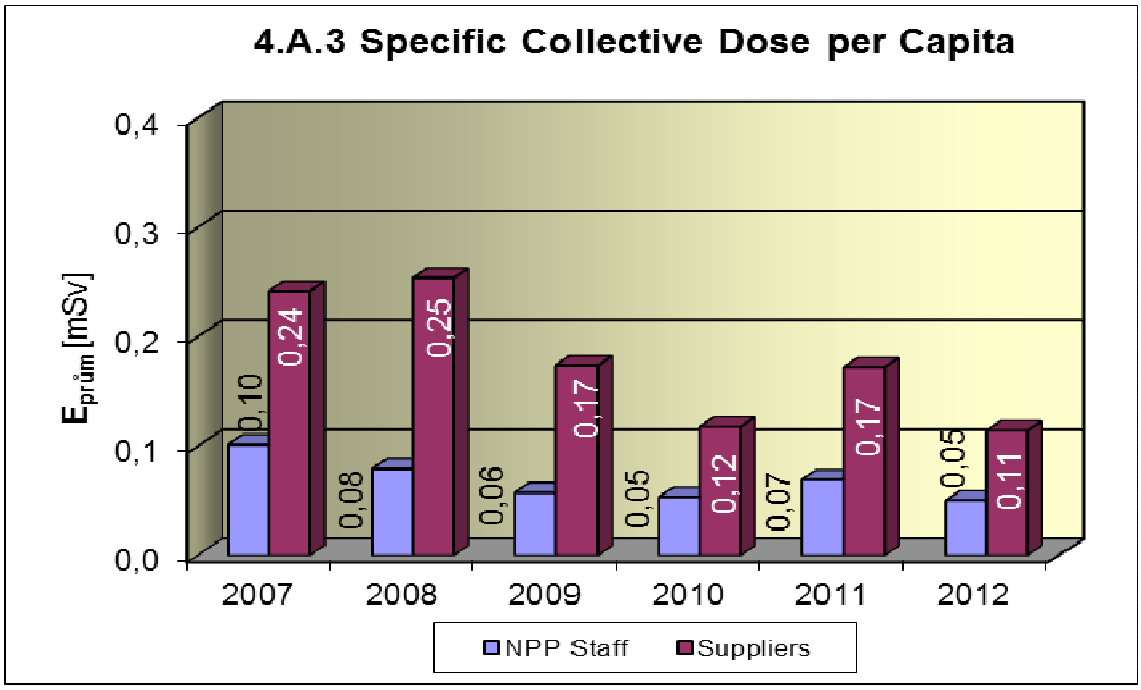
Graph 4.A.1 indicates collective effective dose (CED) received by the staff of NPP (including suppliers and visitors) during monitored period, measured by basic film dosimeters and expressed by mean value per unit.



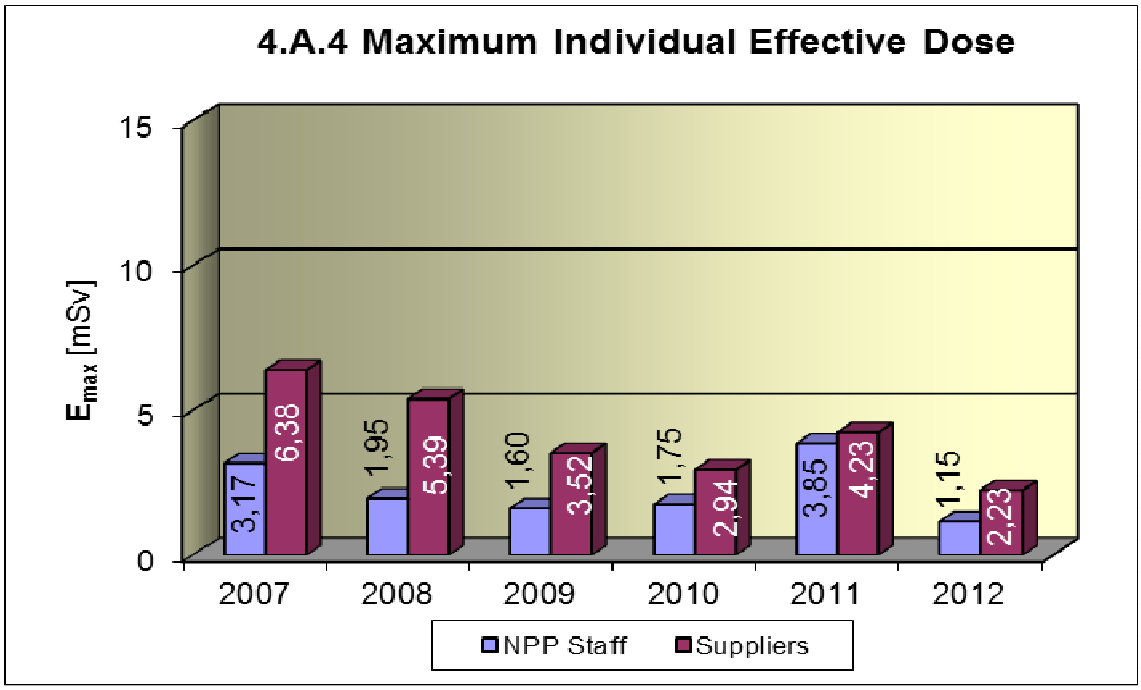

Graph 4.A.2 indicates collective effective dose received by the staff of NPP and suppliers during monitored period, measured by basic film dosimeters.



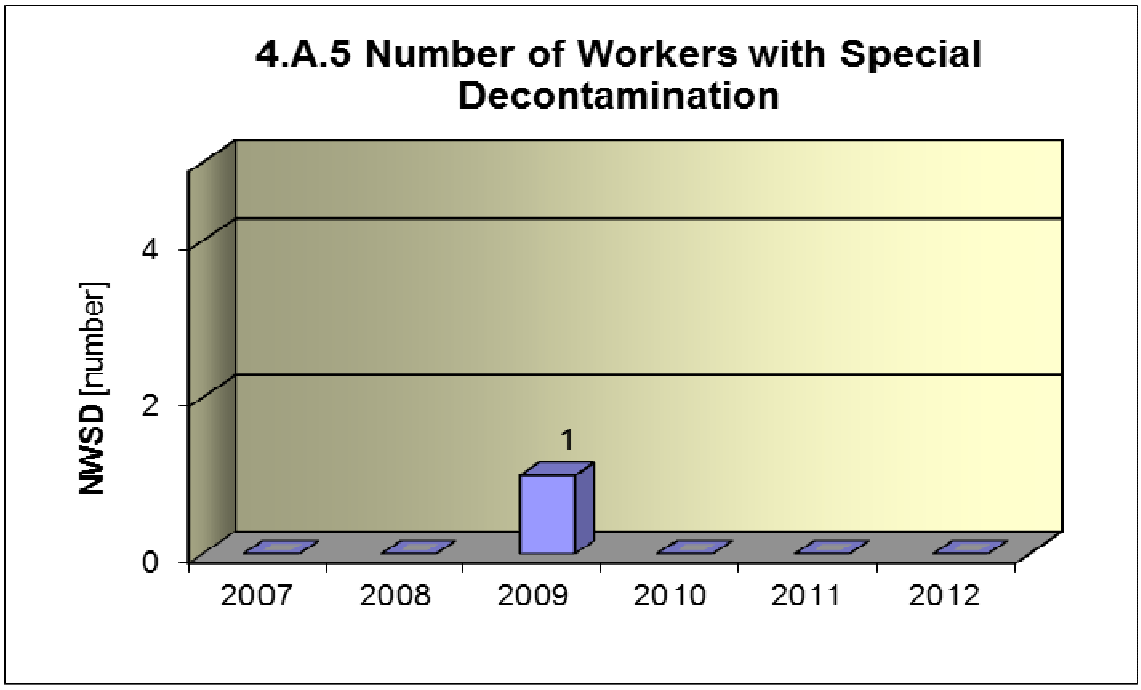
Graph 4.A.3 indicates specific collective effective dose received by the staff of NPP and suppliers during monitored period, measured by basic film dosimeters and express by value per one radiation worker.




Graph 4.A.4 indicates maximum individual effective dose received by one particular employee of NPP and one particular employee of supplier during monitored period, measured by basic film dosimeters.

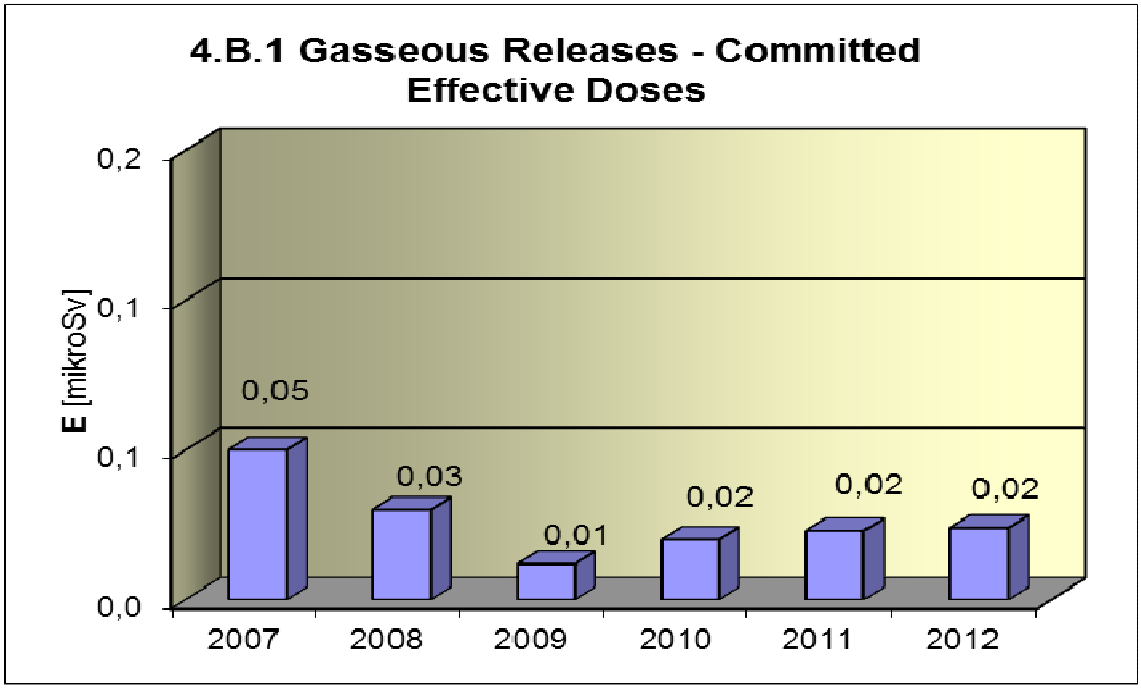


Graph 4.A.5 indicates number of workers (NPP and suppliers) subjected to a special decontamination under medical supervision.



**4.B Radioactive Releases**

Graph 4.B.1 indicates the committed effective dose for an individual, which arises from radioactive gaseous releases from NPP.




Graph 4.B.2 indicates the committed effective dose for an individual, which arises from radioactive liquid releases from NPP.