Working material

OSART mission highlights 2010–2012

Operational safety practices in nuclear power plants

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FOREWORD

The IAEA Operational Safety Review Team (OSART) programme provides advice and assistance to Member States in enhancing the operational safety of nuclear power plants (NPPs). Careful design and high quality of construction are prerequisites for a safe nuclear power plant. However, a plant's safety depends ultimately on the ability and conscientiousness of the operating personnel and on the plant programmes, processes and working methods. An OSART mission reviews a facility's operational performance against IAEA Safety Standards and proven good international practices.

OSART reviews are available to all countries with nuclear power plants in operation, and also approaching operation, commissioning or in earlier stages of construction (Pre-OSART). Most countries have participated in the programme by hosting one or more OSART missions or by making experts available to participate in missions. Operational safety missions can also be part of the design review missions of nuclear power plants and are known as Safety Review Missions (SRMs). Teams that review only a few specific areas or a specific issue are called Expert missions. Follow-up visits are a standard part of the OSART programme and are conducted between 12 to 18 months following the OSART mission.

This report continues the practice of summarizing mission results so that all the aspects of OSART missions are gathered in one publication. It also includes the results of follow-up visits. This report highlights the most significant findings while retaining as much of the vital background information as possible. This report is divided in two main sections.

Chapter 1 summarizes the most significant observations made during the missions and follow-up visits between 2010 and 2012. Chapter 2 describes the mains trends on issues and good practices that were identified in the period covered. Chapter 3 describes the assessment of overall OSART mission results.

Chapter 1 and 2 of the report are intended for different levels of management in the operating and regulatory organizations respectively. Chapter 1 is primarily directed at the executive management level, Chapter 2 at middle managers and those involved in operational experience feedback. Individual findings varied considerably in scope and significance. However, the findings do reflect some common strengths and opportunities for improvement.

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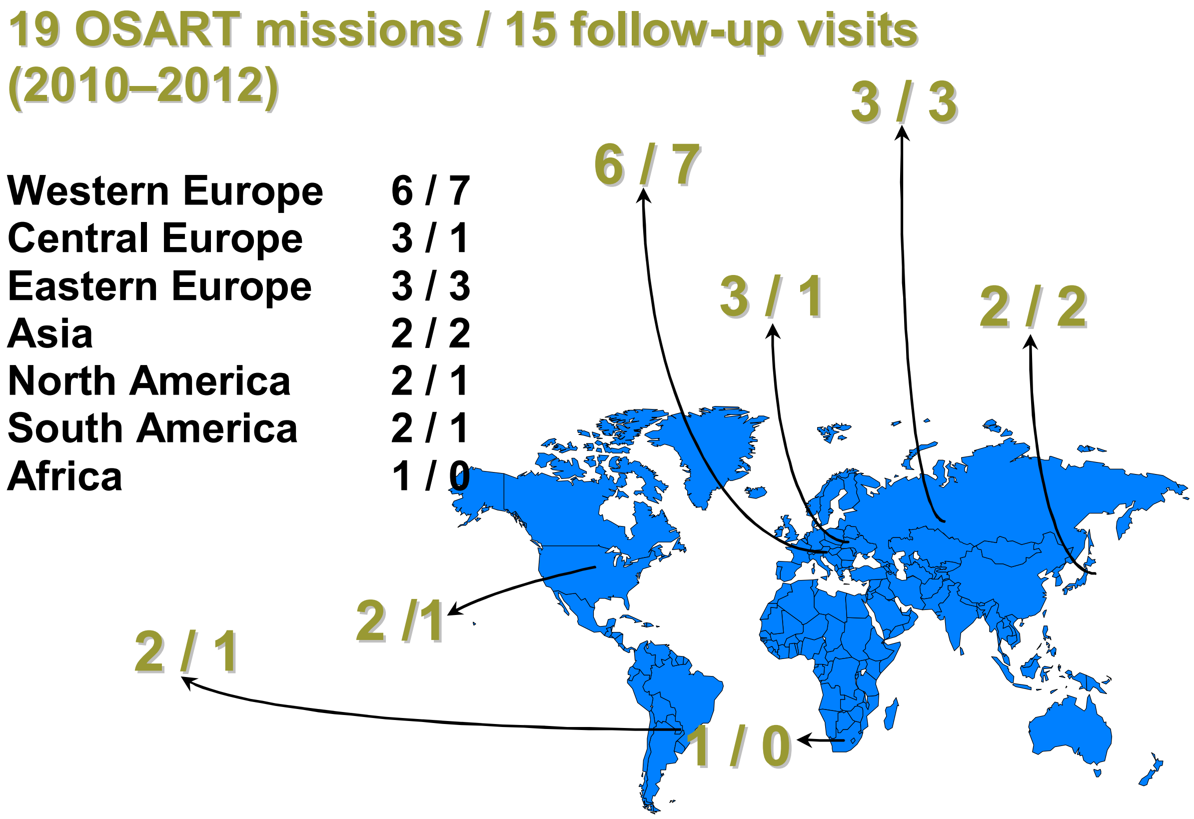
BACKGROUND

Many of the challenges faced by those responsible for ensuring the safe operation of nuclear power plants are common throughout the world. The results of an OSART mission are, therefore, of interest and possible application to many nuclear power plants and not solely to the plant in which they were originally identified. The primary objective of this report is to enable organizations that are constructing, commissioning, operating or regulating nuclear power stations to benefit from experience gained in the course of missions conducted under the OSART programme during the period 2010– 2012.

In 1983, the IAEA set up the Operational Safety Review Team (OSART) programme to assist its Member States in the enhancement of safe operation of nuclear power plants. The service is available to all countries with nuclear power plants under construction, commissioning or in operation upon a request made to the IAEA by its Member States. By the end of 2012, altogether 174 OSART missions had been conducted at 103 nuclear power plants in 34 countries. In addition, 108 follow-up visits have been conducted since 1989, when such visits became a standard feature of the OSART programme. Nineteen (19) OSART missions and fifteen (15) follow-up visits were conducted during the period 2010–2012.



OSART teams consist of senior expert reviewers from NPPs, technical support organizations and regulatory authorities in the various disciplines relevant to the mission. During technical discussions between reviewers and plant staff, operational safety programmes are examined in detail and their performance checked; strengths are identified and listed as good practices and weaknesses are listed as recommendations or suggestions. The criteria used by the teams as they formulate their conclusions are based on IAEA Safety Standards and the best prevailing international practices, and, therefore, may be more stringent than national requirements. OSART reviews are not regulatory inspections nor design reviews. Rather, OSART reviews consider the effectiveness of operational safety programmes and are more oriented to programme, process and management issues than to hardware. The performance or outcome of the various programmes is given particular attention. OSART teams neither assess the adequacy of plant design nor compare or rank the safety performance of different plants.

The OSART missions consist of three basic types: missions to operating power reactors (OSART); missions to power reactors under construction or at the pre-commissioning stage (Pre-OSART); and Expert missions which cover a limited range of topics or which differ in character from review missions. The IAEA also led a Peer Review of the effectiveness of the Operational Safety Performance Experience Review process (PROSPER) and the associated guidelines were issued in April 2003. Operational safety reviews performed in combination with design reviews are known as Safety Review Missions (SRMs).

The results of OSART missions completed by the end of 2009 have been summarized in OSART Results, IAEA-TECDOC-458; OSART Results II, IAEA-TECDOC-497; OSART Mission Highlights, 1988–1989. IAEA-TECDOC-570; OSART Good Practices, 1986–1989, IAEA-TECDOC-605; OSART Mission Highlights, 1989–1990, IAEA-TECDOC-681; Pre-OSART Mission Highlights, 1988–1990. IAEA-TECDOC-763; OSART Mission Highlights 1991–1992, IAEA-TECDOC-797; OSART Programme Highlights 1993–1994, IAEA-TECDOC-874; and OSART Programme Highlights 1995–1996, IAEA-TECDOC-1018; OSART mission highlights 2001–2003 – IAEA-TECDOC-1446; OSART mission highlights 2003–2006 and OSART mission highlights 2007–2009. Since 1996, the results of OSART missions have been made available to Member States on the OSART Mission Results Database.
The OSART reviews normally cover ten standard review areas, namely: management, organization and administration (MOA); training and qualification (TQ); operations (OPS); maintenance (MA); technical support (TS); operating experience feedback (OE), radiation protection (RP); chemistry (CH); emergency planning and preparedness (EPP) and severe accident management (SAM). Among these, SAM was introduced as a standard area in the light of the accident at the Fukushima Daiichi nuclear power plant. In addition to these standard review areas, four optional review areas can be applied to OSART missions depending on the needs of Member States. They are commissioning (COM), long term operation (LTO), preparedness for transition from operation to decommissioning (TRA) and independent safety culture assessment (ISCA).

The OSART Guidelines were revised in June 2005 (Services Series number 12). During the review, recent INSAG Reports (INSAG-13, INSAG-15, INSAG-18, INSAG-19) and requirements of relevant recent Safety Guides (NS-G-2.4, NS-G-1.1) were incorporated. The IAEA Safety Review Services were evaluated by an external audit and it was recommended to promote the integrated approach to safety assessment. This was also taken into account in the revised version of the guidelines.

Over the thirty years of experience with the OSART programme, significant changes have taken place in the OSART methodology, nuclear industry transparency and operational safety practices at power plants for in-depth reviews of operational safety. In this period, the guidelines and experience of OSART team members have also evolved to reflect the higher standards for operational safety practices now being adopted worldwide.

The terms 'recommendation', 'suggestion' and 'good practice' are defined as follows in the framework of OSART reviews:

Recommendation

A recommendation is advice on what improvements in operational safety should be made in that activity or programme that has been evaluated. It is based on IAEA Safety Standards or proven, good international practices and addresses the root causes rather than the symptoms of the identified concern. It very often illustrates a proven method of striving for excellence, which reaches beyond minimum requirements. Recommendations are specific, realistic and designed to result in tangible improvements. Absence of recommendations can be interpreted as performance corresponding with proven international practices.

Suggestion

A suggestion is either an additional proposal in conjunction with a recommendation or may stand on its own following a discussion of the pertinent background. It may indirectly contribute to improvements in operational safety, but is primarily intended to make a good performance more effective, to indicate useful expansions to existing programmes and to point out possible superior alternatives to on-going work. In general, it is designed to stimulate the plant management and supporting staff to continue to consider ways and means for enhancing performance.

Note: if an item is not well based enough to meet the criteria of a 'suggestion', but the expert or the team feels that mentioning it is still desirable, the given topic may be described in the text of the report using the concept of 'encouragement' (e.g. The team encouraged the plant to…).

Good practice

A good practice is an outstanding and proven performance, programme, activity or equipment in use that contributes directly or indirectly to operational safety and sustained good performance. A good practice is markedly superior to that observed elsewhere, not just the fulfilment of current requirements or expectations. It should be superior enough and have broad application to be brought to the attention of other nuclear power plants and be worthy of their consideration in the general drive for excellence. A good practice has the following characteristics:

- it is novel;
- it has a proven benefit;
- it is replicable (it can be used at other plants);
- it does not contradict an issue.

The attributes of a given 'good practice' (e.g. whether it is well implemented, or cost effective, or creative, or it has good results) should be explicitly stated in the description of the 'good practice'.

Note: An item may not meet all the criteria of a 'good practice', but still be worthy.. In this case it may be referred to as a 'good performance', and may be documented in the text of the report. A good performance is a superior objective that has been achieved or a good technique or programme that contributes directly or indirectly to operational safety and sustained good performance, that works well at the plant. However, it might not be necessary to recommend its adoption by other nuclear power plants, because of financial considerations, differences in design or other reasons.

1. INTRODUCTION AND MAIN CONCLUSIONS

1.1. Summary

During the period 2010–2012, 19 OSART missions listed below reviewed plants around the world. As a result, this report contains the accumulated findings (good practices, recommendations and suggestions) that present a series of snapshots of the status of operational safety practices at NPPs.

Plant	Country	Year
Ringhals 3/4	Sweden	2010
Doel	Belgium	2010
St.Alban	France	2010
Bohunice 3/4	Slovakia	2010
Angra 2	Brazil	2011
Metzamor	Armenia	2011
Dukovany	Czech	2011
Seabrook	USA	2011
Koeberg	South Africa	2011
Smolensk	Russia	2011
Cattenom	France	2011
Hongyanhe	China	2012
Angra1	Brazil	2012
Laguna Verde	Mexico	2012
Muhleberg	Switzerland	2012
Rajasthan	India	2012
Temelin	Czech Rep.	2012
Gravelines	France	2012
kozloduy	Bulgaria	2012

The IAEA evaluated the general trends and achievements derived from these OSART missions and these are presented in this report.

The lower number of issues observed during the missions reflects an increased level of compliance with the IAEA safety standards by almost all the plants reviewed. Meanwhile, the high number of good practices recorded shows a high level of implementation of the best international practices in the industry. In this sense, plant managements and staff show that they clearly understand the importance of nuclear safety.

At many plants, the OSART teams were impressed by the level of preparation for the review, the openness of the counterpart teams and their readiness to cooperate.

While the nuclear industry has made significant advances in safety, there is always room for further improvement: OSART teams have identified many operational safety aspects where improvements are still needed. At the same time, the assessment teams and plants reviewed have provided the IAEA with valuable feedback that allows continuous improvement of the IAEA services aimed at operational safety review and enhancement.

The table below shows the number of issues (Recommendations + Suggestions = 343) and the number of Good Practices = 151) provided to the plants during the 19 OSART missions. All these findings form the basis of the evaluation proposed in the present report.

	MOA	TQ	OPS	MA	TS	OEF	RP	CH	EPP	COM	LTO	TRA	ISCA	SAM	Total
Issues	**39**	**15**	**56**	**41**	**36**	**39**	**36**	**34**	**21**	**3**	**5**	**3**	**3**	**12**	**343**
(Rec.)	20	6	30	16	14	16	17	14	14	3	2	2	1	5	160
(Sug.)	19	9	26	25	22	23	19	20	7	0	3	1	2	7	183
Good Practices	**13**	**18**	**16**	**20**	**11**	**14**	**20**	**14**	**13**	**0**	**1**	**0**	**0**	**11**	**151**
Applied Missions	19	16	19	19	19	19	19	19	15	1	2	1	2	8	-

*Review areas written in red are standard review areas, and others are optional areas. SAM was introduced as a standard review area in the light of the accident at the Fukushima Daiichi nuclear power plant.
*In one of 2 missions where ISCA was reviewed, 3 issues were identified. However, these issues are not included in the table above, because the terms 'recommendation' and 'suggestion' are not used for those issues in the review report.

The main task of the assessment team formed by the IAEA was to evaluate and give a weight to the evaluation. To effectively transpose in wording statistical results, the group of experts decided to use the following statements:
– "In many plants" or "frequently" is used for a number of issue items found in about 10 to 18 plants out of 19 missions (more than 50% of the cases). (TQ; 8 to 15, EPP; 8 to 14)
– "In some plants" reflects that in 4 to 9 plants out of 19, the OSART missions found the same issue topic (from 15% to 50% of the cases). (TQ; 3 to 7, EPP; 3 to 7)
– "In a few plants" means that the frequency of finding or the equivalent sort of issues appears in 2 or 3 plants against 19 visits (up to 15% of the cases). (TQ; 2, EPP; 2)

LTO and SAM were reviewed only in 2 and 8 missions respectively as an independent review area. However these 2 review areas are considered to be reviewed in all missions when trends are stated, because these 2 areas were partly covered by TS and OPS respectively.

The tendencies which are obtained from the assessment of Issues and Good Practices of 19 OSART missions are arranged to "Trends" for each review area.

1.2. Summary of trends classified by area

• Management, organization and administration

– In a few plants, there are indications of lack of the robust review mechanisms of safety performance and safety related plans at the plant. (2/19)

– In a few plants, there are indications that the plants have a programme to have numbers of personnel holding the senior reactor license or shift supervisor license in the departments other than the operational department. (2/19, Good practice)

– In some plants, there are indications that there were some gaps between the management expectations and the actual status of work quality, material conditions, housekeeping and so on. (4/19)

– In some plants, there are indications that the performance indicators were not fully effective to improve operational safety of the plants. (7/19 (including 2 issues identified in TS))

– In a few plants, there are substantial backlogs of safety related modernisation works and work orders due to procurement process and difficulties in timely delivery of spare parts. (3/19)

– In many plants, there are indications that the industrial safety policies or programmes are established, but they are not fully implemented/followed in the field. (10/19).

• **Training and qualifications**

– In some plants, the effectiveness of the training and training method are not systematically evaluated. (3/16)

– In a few plants, the simulator facility does not fully reflect the status of the plant. (2/16)

– In some plants, there are training facilities which enable plant and contractor personnel to train in realistic field conditions. (3/16, Good practice)

– In some plants, modern simulators and mock-ups to simulate specific works such as flange connection, refuelling and operation of the digital control system are implemented. (3/16, Good practice)

– In a few plants, continuing training /retraining is not consistently implemented on a regular basis. (2/16)

– In a few plants, there are inadequate training programmes for trainers who are in charge of on-the-job training (OJT). (3/16)

• **Operations**

– In some plants, the plant's management expectations in operations are not well communicated, re-enforced and consequently not well understood and/or followed by the operations personnel. (6/19)

– In a few plants, the electronic logging system has been developed and used successfully. (2/19, Good practice)

– In many plants, the control of operator aids is not maintained in a rigorous manner. (10/19)

– In some plants, operating rules and procedures are not sufficiently comprehensive. (6/19)

– In a few plants, control of personnel access to the main control room (MCR) has some deficiencies. (2/19)

– In some plants, operations field personnel are not identifying and reporting field deficiencies in a systematic manner. (8/19)

– In a few plants, error prevention tool and pre-job-briefing are not rigorously used or well prepared when manipulating safety systems. (3/19)

– In many plants, the fire prevention and protection programme is not strictly implemented. (15/19)

• Maintenance

– In a few plants, maintenance equipment is not well maintained in terms of the storage and calibration control. (2/19)

– In a few plants, the maintenance programme is not fully effective in terms of clear criteria for and completeness of preventive programmes. (2/19)

– In a few plants, the maintenance procedures are not always correct and comprehensive. (2/19)

– In some plants, the control of maintenance activities is insufficient that leads to unsafe work practice and behaviour. (8/19)

– In some plants, the foreign material exclusion (FME) programme is not fully comprehensive and not consistently and effectively applied. (5/19)

– In many plants, there is a need to improve their material conditions programmes and reinforce their implementation. (11/19 (including one issue identified in TS))

– In a few plants, the work control process is not always effective to ensure timely completion of maintenance works and prevent high number of backlogs. (2/19)

– In a few plants, there are indications that plant policies for the timely supply and control of spare parts and hazardous materials are not followed. (3/19)

• Technical support

– In a few plants, the plant specific probabilistic safety analysis (PSA) model is not sufficiently developed and not fully utilised as a tool for operational decision making. (2/17)

– In a few plants, the plant safety analysis report does not reflect the current plant status. (2/19)

– In a few plants, the periodic safety review (PSR) is not sufficient in terms of scope, duration and frequency. (2/19)

– In a few plants, operational controls to minimise damage due to a seismic event are not consistently applied. (2/19)

– In some plants, the plant surveillance programme is not sufficiently developed, implemented and evaluated. (6/19)

– In some plants, the management of temporary modifications is not adequately performed. (6/19)

– In some plants, different elements of the modification process, such as modification categorization, human factor consideration, documentation update and modification control should be enhanced. (5/19)

• **Operating experience feedback**

– In some plants, the operating experience programmes are not sufficiently developed and effectively implemented to enhance operational safety. (7/19)

– In some plants, low level events (LLEs) and near misses (NMs) are not reported in a systematic and consistent manner. (7/19)

– In some plants, the root cause analysis is not effective enough to prevent the recurrence of events. (6/19)

– In some plants, the event analysis is not timely performed to the required depth and rigor. (5/19)

– In a few plants, the corrective action programme is not robust enough. (3/19)

– In a few plants, the effectiveness of the Operating Experience (OE) programme is not sufficiently assessed. (2/19)

• **Radiation protection**

– In many plants, contamination control practices and measures for preventing the spread of contamination are not comprehensive and sufficient in the field. (13/19)

– In some plants, radiological work permit (RWP) does not always include appropriate information or is not fully followed by the plant personnel. (4/19)

– In some plants, measures and arrangements undertaken to further reduce the exposure of individuals are insufficient. (4/19)

• **Chemistry**

– In some plants, the chemistry control programmes are not sufficiently comprehensive to identify, trend and minimize corrosion processes and deal with all chemistry aspects of safety related systems. (6/19)

– In a few plants, the operability of the liquid and gaseous post-accident sampling system and methods are not properly ensured. (2/19)

– In many plants, the quality control of operational chemicals and other substances is not appropriate. As a consequence, the procedures for management of chemicals (for example purchase, storage and labelling) are not sufficiently implemented. (14/19)

• **Emergency planning and preparedness**

– In a few plants, there is strong support for the public to be effectively prepared for an emergency. (2/15, Good practice)

– In some plants, there is no individual person on-site around the clock with the authority and responsibility to initiate the on-site emergency plan and notify the appropriate off-site notification point. (4/15)

– In some plants, the protection of emergency workers and evacuees in an emergency situation is not fully effective. (7/15)

– In a few plants, field monitoring data transmission system is developed. (2/15, Good practice)

– In some plants trainings, drills and exercises are not comprehensive and do not cover real emergency conditions. (4/15)

• **Commissioning**

– Not applicable. (Reviewed in only one mission)

• **Long term operation**

– In a few plants, the ageing management programme is not comprehensive and scoping of SSCs for LTO is not complete. (4/19 (including one issue identified in MA and TS respectively))

– In a few plants, Equipment Qualification (EQ) is limited or not completely revalidated for LTO. (2/19)

• **Preparedness for transition from operations to decommissioning**

– Not applicable. (Reviewed in only one mission)

• **Independent Safety Culture Assessment**

– No trends.

• **Severe accident management**

– In some plants, SAMP does not cover all accident situations at site. (6/19 (including 3 issues identified in OPS))

– In a few plants, SAMG is extended to scope accidents during shutdown conditions and accidents involving the spent fuel pool. (2/19, Good practice)

– In a few plants, available plant specific inputs for mitigative accident management actions in SAMGs are not sufficient for validation of SAMGs. (2/19)

– In a few plants, SAMP is not yet fully implemented and the execution plan for future steps is insufficient. (2/19)

All trends with two and more occurrences out of the 19 missions are listed and evaluated.

	MOA	TQ	OPS	MA	TS	OEF	RP	CH	EPP	LTO	SAM	Total
Negative Trends	5	4	7	8	7	6	3	3	3	2	3	51
Good practices	1	2	1	0	0	0	0	0	2	0	1	7

2. ASSESSMENT OF THE OSART MISSIONS RESULTS AREA BY AREA

The following summarizes the trends and tendencies identified in the findings.

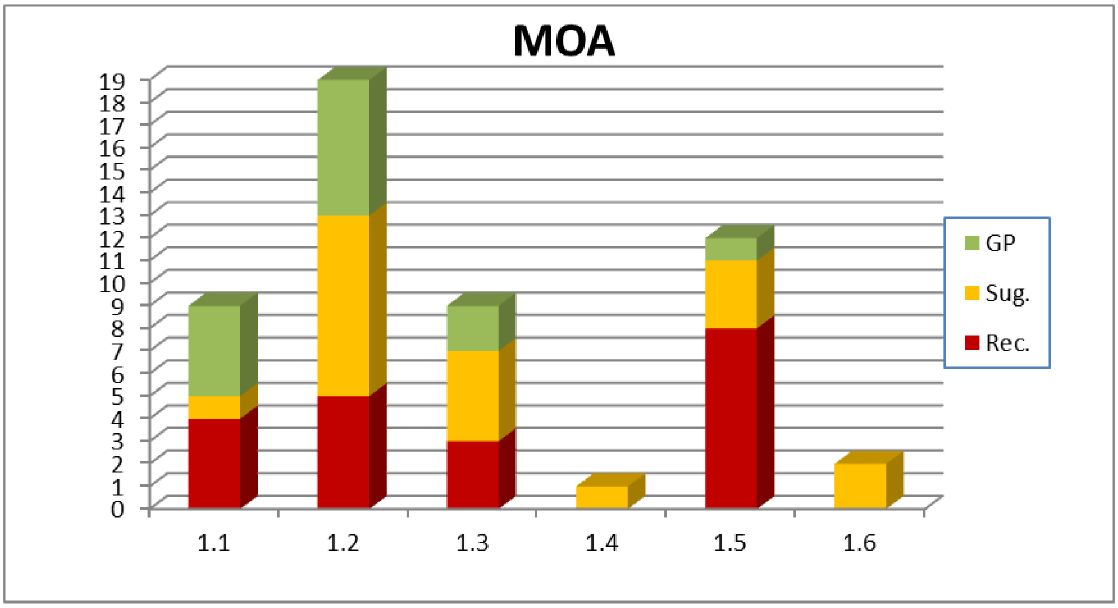
Important trends are highlighted by a bullet; they can be used as stand-alone input to other evaluative documents. Where the facts or findings of the OSART missions address a common problem, the trend is complemented by several examples of observation, a discussion on the weight of these findings and possible remedial actions.

2.1. Management, organization and administration

2.1.0. Summary of findings

The review of the MOA area in the 19 visited plants resulted in 52 findings of which 20 are recommendations, 19 are suggestions and 13 are good practices. The distribution of the findings between the different topics of the MOA review is presented below:

Title		Rec.	Sug.	GP	Total
1.1	Organization and administration	4	1	4	9
1.2	Management activities	5	8	6	19
1.3	Management of safety	3	4	2	9
1.4	Quality assurance programme	0	1	0	1
1.5	Industrial Safety programme	8	3	1	12
1.6	Document and records management	0	2	0	2
Total		20	19	13	52



2.1.1. Organization and administration

• Findings: 4 recommendations, one suggestion, 4 good practices

<u>• Trend: In a few plants, there are indications of lack of the robust review mechanisms of safety performance and safety related plans at the plant. (2/19 (including one issue identified in 2.1.2))</u>

Examples show that:
– There is no independent, systematic review and reporting the on-going safety performance from the plant to the utility CEO.
– There is no documented information regarding the station's important strength and weakness to support the station's safety related planning.

The plants should put in place robust review mechanisms with the corporate management to ensure safe operation of the plant.

• Other issues are related to the lack of overview of open actions, instability in the structure and competent permanent personnel, quality control of the contractors/suppliers and significant backlog.

<u>• Trend: In a few plants, there are indications that the plants have a programme to have numbers of personnel holding the senior reactor license or shift supervisor license in the departments other than the operational department. (2/19, Good practice)</u>

This practice can improve the decision-making process with regard to the safe operation of the plant.

• Other good practices are related to risk ranked activities evaluations to monitor contractors in the field and use of an educational board game to enhance the understanding of the business cycle with the essential focus on safety.

2.1.2. Management activities

• Findings: 5 recommendations, 8 suggestions, 6 good practices

<u>• Trend: In some plants, there are indications that there were some gaps between the management expectations and the actual status of work quality, material conditions, housekeeping and so on. (4/19)</u>

Examples show that there are two reasons for the gap between the management expectations and the actual behaviour and practices of the plant personnel. Firstly, plant policies and respective management expectations are not clearly and adequately communicated to the whole staff in rigorous manner. Secondly, the expectations are not sufficiently supported and reinforced by the management team.

<u>• Trend: In some plants, there are indications that the performance indicators are not fully efficient to improve operational safety of the plants. (7/19 (including 2 issues identified in 2.5.1))</u>

Examples show that
– The set of performance indicators are not always sufficient, e.g. lack of performance indicators for specific activities, not utilizing worldwide nuclear industry performance indicators for benchmarking.
– The performance indicator management is not consistently applied across all plant departments and did not efficiently support planning, trending, oversight and easy communication across the plant.

To improve safe plant operation, plants should utilize data collected for specific KPI to confirm trends or discover shortfalls. Rigorous selection of an appropriate set of performance indicators and their proper management would benefit proactive plant management and safe plant operation.

• Other issues are related to insufficient use of human performance tools, unjustified operational limits and conditions, ineffective integrated management system and insufficient field observations by managers.

• There are good practices regarding competency grades to measure safety culture and reduce human errors, close cooperation with technical support organizations, research and design organizations, use of video communication tool to ensure operational focus on topics such as decision making and safety, systematically organized internal and external communications, fast and broad communication to the entire plant staff and pocket-sized aid to determine time frames for modular work planning and scheduling. Although there are several good practices related to communications, no clear trend is found.

2.1.3. Management of safety

• Findings: 3 recommendations, 4 suggestions, 2 good practices

• Trend: In a few plants, there are substantial backlogs of safety related modernisation works and work orders due to procurement process and difficulties in timely delivery of spare parts. (3/19 (including two issues identified in 2.1.1))

Examples show that

– Programme of appropriate magnitude for the replacement of obsolete equipment with modern technology is not available.
– Proactive strategies to resolve long term issues are not in place.
– Use of systematic approach to analyse work order backlog in order to evaluate cumulative impact on system reliability is not in place.

• Other issues are regarding behaviour of the plant personnel concerning identification and rectification of deficiencies, development of programmes important for safety and approach to conservative decision making; however there are no trends on these findings.

• The good practices are related to independent nuclear safety oversight organization at utility level and area coordinators for improvement of housekeeping.

2.1.4. Quality assurance programme

• Findings: No recommendation, one suggestion, no good practice

• No trends

• There is one issue that quality assurance and the control of documentation were not systematically addressed and implemented, e.g. unrecorded amendments/changes, steps completed but not signed, reference and date not mentioned etc.

2.1.5. Industrial safety programme

• Findings: 8 Recommendations, 3 suggestions, one good practice

<u>• Trend: In many plants, there are indications that the industrial safety policies or programmes are established, but they are not fully implemented/followed in the field. (10/19).</u>

Examples show that;
– Plant personnel not always wearing safety protective means (goggles, hard-hats, gloves, ear-protection tools etc.).
– Some plant equipment is missing or has disconnected grounding cables.
– Lighting defects are not always eliminated in timely manner.
– Electrical and other cabinets have no safety hazard warning labels.
– There are number of unlocked electric/ I&C cabinets.
– Escape routes are not appropriately marked.

Though plants have established policies, standards and expectations on industrial safety that employees are required to meet, there are strong indications that behaviour in the field did not fully comply with these policies, standards and programmes. Management must put additional efforts to recover the situation and to ensure that expectations are communicated and reinforced repeatedly to make plant staff and contractors understand the industrial safety policies and strictly follow them in the field. This trend requires thorough analysis of the situation at the plants where the deficiencies were found and development of the respective corrective actions – training, posters, industrial safety days etc.

• Other issue is related to the storage of safety documents.

• There is one good practice related to the development of booklet "Awareness for lifting" supported by simple tool to quickly evaluate appropriateness of lifting arrangements in the field.

2.1.6. Document and records management

• Findings: No recommendation, 2 suggestions, no good practice

• No trends

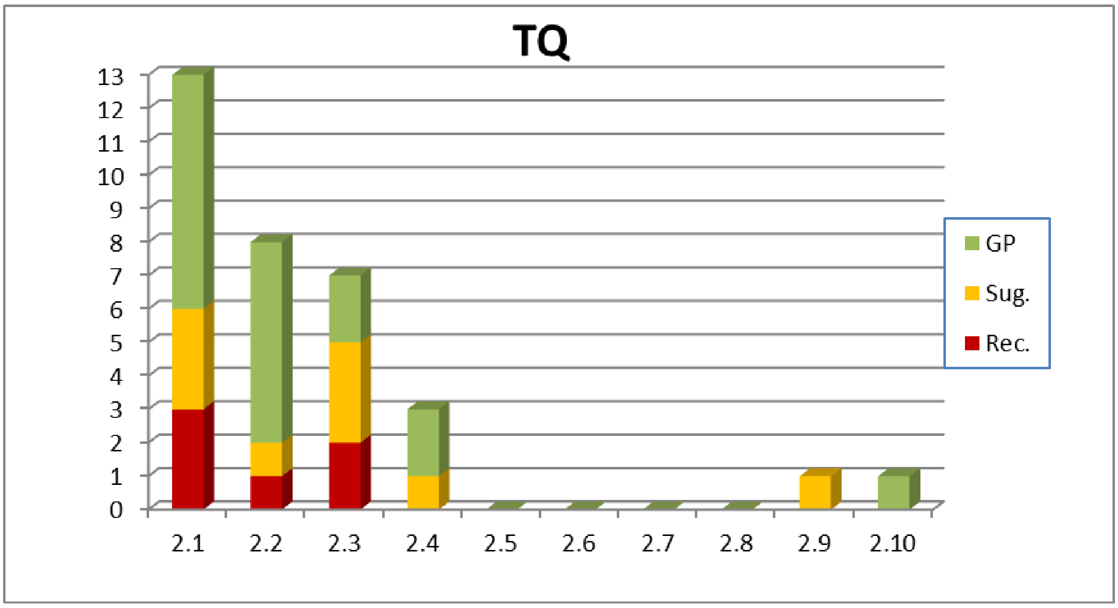
• One issue is regarding storage conditions of safety documents and the other is that some important operational documents were not available in a language appropriate to some of the operational staff.

2.2 Training and qualification

2.2.0. Summary of findings

The review of the TQ area at the 16 OSARTs resulted in 33 findings from which there were 18 good practices, 6 recommendations and 9 suggestions.
The distribution of the findings between the different topics of the TQ review is presented in the table below:

Title		Rec.	Sug.	GP	Total
2.1	Training policy and organization	3	3	7	13
2.2	Training facilities, equipment and material	1	1	6	8
2.3	Quality of the training programmes	2	3	2	7
2.4	Training programmes for control operators and shift supervisors	0	1	2	3
2.5	Training programmes for field operators	0	0	0	0
2.6	Training programmes for maintenance personnel	0	0	0	0
2.7	Training programmes for technical plant support personnel	0	0	0	0
2.8	Training programmes for management and supervisory personnel	0	0	0	0
2.9	Training programmes for training group personnel	0	1	0	1
2.10	General employee training	0	0	1	1
Total		6	9	18	33



2.2.1. Training policy and organization

• Findings: 3 recommendations, 3 suggestions, 7 good practices

<u>• Trend: In some plants, the effectiveness of the training and training methods are not systematically evaluated. (3/16)</u>

Examples show that:
– Performance based self-assessments of training effectiveness are not used.
– Key performance indicators for the training process do not include an assessment of training effectiveness.
– The effectiveness of the management training programme is not evaluated.

A rigorous approach in implementing effective training should be in place to ensure continuous improvement of the quality of training.

• Other issues are related to inappropriate storage of the training records, insufficient plant oversight of training insufficient number of operators training staff and fact that high level training standards and Systematic Approach to Training (SAT) are not always used.

• Although there are 7 good practices, no trends are found. They are related to integrated approach for recruiting and selection, learning management system, qualification health report, self- evaluation programme, knowledge management, system for the management of training activities and skill mapping.

2.2.2. Training facilities, equipment and material

• Findings: One recommendation, one suggestion, 6 good practices

• Trend: In a few plants, the simulator facility does not fully reflect the status of the plant. (2/16)

Examples show that
– There are no procedural requirements to upgrade the simulator and procedures on timely – regular basis.
– Modification of the reactor protection system is yet to be implemented at the simulator.
– Some training materials are not updated/revised on regular basis.
– Simulator facilities do not always fully reflect the status of the plant to effectively train Operations Crew particularly in accident conditions:
  - Non full replica of Remote Shutdown Panel
  - Difference between Simulator and actual control room I&C
  - Lack of training in Self Contained Breathing Apparatus

The simulator facilities should accurately reflect the status of the plant to effectively train operations crews.

• Other issues are associated with a lack of training materials for On-the-Job Training (OJT).

• Trend: In some plants, there are training facilities which enable plant and contractor personnel to train in realistic field conditions. (3/16, Good practice)

Examples show that:
– A field operator radiological protection practical training facility is in place.
– The worksite training facility has simple pieces of mechanical plant which represent various work situations with numerous scenarios, e.g. contamination, working at heights or in a tank, use of hazardous materials.

– The shutdown plant is used as training facility for operations and maintenance personnel in real low doses environment.
– The plant has a plant simulator (mock up) utilizing panels and components of the turbine systems of adjacent permanently shut-down unit.

• Trend: In some plants, modern simulators and mock-ups to simulate specific works such as flange connection, refuelling and operation of the digital control system are implemented. (3/16, Good practice)

2.2.3. Quality of the training programmes

• Findings: one recommendation, 3 suggestions, 2 good practices

• Trend: In a few plants, continuing training /retraining is not consistently implemented on a regular basis. (2/16)

Examples show that:
– There are cases when no requirements to undertake retraining are in place (for example in the engineering and chemistry departments, internal operating experience and emergency planning groups).
– Continuing leadership programme is not fully developed and established for all levels of leadership in the organization.

The trend shows that plants should develop and/or review comprehensive continuing training programme for all plant staff.

• Trend: In a few plants, there are inadequate training programmes for trainers who are in charge of on-the-job training (OJT). (3/16)

Examples show that:
– Training methods do not impose continuing training for OJT trainers.
– Training in pedagogy for OJT trainers is not a requirement in training policies and programmes.
– OJT trainers receive adult learning training and evaluation skills training only occasionally.

The plants should consider in their training programmes/policies measures to ensure appropriate training and qualification of the OJT instructors including coaching and tutorial skills.

• There are 2 good practices related to training to boost new trainee memory and training for parallel installation of I&C modernization and power uprate.

2.2.4. Training programmes for control room operators and shift supervisors

• Findings: no recommendation, one suggestion, 2 good practices

• No trends

• One specific case was related to inappropriate training practices (unauthorised operator aids) and arrangements (distractive environment – external noise, cell-phones etc.), deficiency in facilities (unit modernisation not reflected at full scope simulator) and thus certain negative impact on training efficiency.

• The good practices are related to comprehensive station blackout training and sharing of duties of simulator instructors and shift supervisors.

2.2.5. Training programmes for field operators

• No findings.

2.2.6. Training programmes for maintenance personnel

• No findings.

2.2.7. Training programmes for technical support personnel

• No findings.

2.2.8. Training programmes for management and supervisory personnel

• No findings.

2.2.9. Training programmes for training group personnel

• Findings: no recommendation, one suggestion, no good practice

• No trends

• One specific case was related to inadequate continuous training for the instructors and irregularities and lack of training for the adults' learning skills.

2.2.10. Training programmes for general employee training

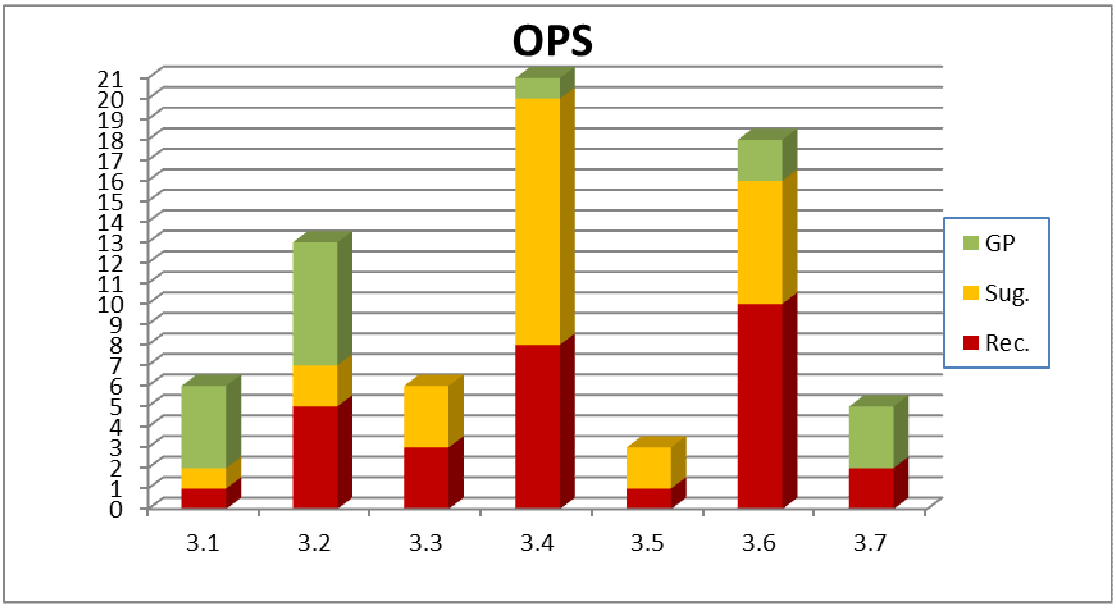
• No findings.

2.3. Operations

2.3.0. Summary of findings

The review of the OPS area in the 19 visited plants resulted in 72 findings of which 30 are recommendations, 26 are suggestions and 16 are good practices.
The distribution of the findings between the different topics of the OPS review is presented below:

Title		Rec.	Sug.	GP	Total
3.1	Organization and functions	1	1	4	6
3.2	Operations facilities and aids	5	2	6	13
3.3	Operating rules and procedures	3	3	0	6
3.4	Conduct of operations	8	12	1	21
3.5	Work authorization	1	2	0	3
3.6	Fire prevention and protection programme	10	6	2	18
3.7	Management of accident conditions	2	0	3	5
Total		30	26	16	72



2.3.1. Organization and functions

• Findings: one recommendation, one suggestion, 4 good practices

• Trend: In some plants, the plant's management expectations in operations are not well communicated, re-enforced and consequently not well understood and/or followed by the operations personnel. (6/19 (including 4 issues identified in 2.3.4))

Examples show that:
– Managers and supervisors do not consistently correct and coach plant workers behaviour when plant processes are not followed, do not intervene if observe inappropriate/ not compliant with their expectations behaviour.
– Numerous deficiency cards older than one year are observed.
– Housekeeping is not always at high level.
– Shift-logs are missing or unsigned.

Management expectations should be clearly defined, adequately communicated, and regularly re-enforced to ensure these expectations are well understood and applied correctly by operations personnel. In addition to that, the performance of operations personnel in view of fulfilling the management expectations should be adequately monitored and assessed on regular basis.

• The good practices are related to internal checking by each shift team, operational focus performance indicator, operating observation and coaching programme and coaching in simulator training by experienced shift engineers.

2.3.2. Operations facilities and operator aids

• Findings: 5 recommendations, 2 suggestions, 6 good practices

• Trend: In a few plants, the electronic logging system has been developed and used successfully. (2/19, Good practice)

Examples show that:
– Information from the shift about important on-going activities is available on the system.
– The system automatically generates a reminder of regular activities.
– Various departments use this system as an official log for daily activities.

This system is expected to improve the flow of information and communication between relevant groups and departments.

• Other good practices are related to information system on the reactor status for reactor operators, improved plant labelling, improvement of emergency control room and post Fukushima plant power supply improvement.

• Trend: In many plants, the control of operator aids is not maintained in a rigorous manner. (10/19 (including 6 issues identified in 2.3.4))

Examples show that:
– Unauthorized operator aids (circuit diagrams, sketches, labels, tags etc.) are used.
– Labels are missing or obsolete.
– There are handwritten corrections in the alarm sheet.

Adequate control of operator aids is a prerequisite to ensure safe operation of the plant.

• 2 good practices are related to identification and notification of field deficiencies, and counted in a trend in 2.3.4. Others are concerning inappropriate procedural guidance for control room environment, unsuitable condition of control room equipment and facilities and inconsistent control of alarms.

2.3.3. Operating Rules and Procedures

• Findings: 3 recommendations, 3 suggestions, no good practice

• Trend: In some plants, operating rules and procedures are not sufficiently comprehensive. (6/19)

Examples show that:
– Emergency operating procedures are not validated.
– Emergency operating procedures do not have symptom oriented features.
– Operating technical specifications do not cover all safety related systems.
– Plants do not have or do not rigorously follow formal review process.
– Some specific alarm reference procedures do not exist, are not detailed enough or not used by operations upon receipt of alarm.

Operating rules and procedures should be regularly reviewed in terms of correctness and comprehensiveness.

In 2 cases out of 6 cases above, the incomprehensiveness of the accident management programme were identified. Therefore, these 2 cases are counted in 2.14 as well.

2.3.4. Conduct of operations

• Findings: 8 recommendations, 12 suggestions, one good practice

• Trend: In a few plants, control of personnel access to the main control room (MCR) has some deficiencies. (2/19)

Examples show that:
– Some personnel enter the MCR without permission.
– Some plant staff continues to wear hard hats during being in the MCR.
– The formal limitation to the number of personnel present in the MCR is not strictly followed.

The access of plant staff to the MCR should be properly controlled to avoid distracting to the MCR operators.

• Trend: In some plants, operations field personnel are not identifying and reporting field deficiencies in a systematic manner. (8/19 (including 2 issues identified in 2.3.2))

Examples show that:
– There are long standing deficiencies in the field such as oil or water leaks, missing hand wheels of valves and unreadable labelling.
– Inappropriate tagging practices are used.

Observations and corrective actions by field operators regarding deficiencies and labelling support the safe operation of the plant in all operating conditions.

• Trend: In a few plants, error prevention tool and pre-job-briefing are not rigorously used or well prepared when manipulating safety systems. (3/19)

Examples show that:
– 3 way communication are not used in some cases.
– Important information such as operational experiences from previous activities is not provided in the pre-job briefing.

– Pre-job briefing are performed without support documents and do not consider experience feedback.
– The self-checking is not performed appropriately during training with the simulator.

Strict adherence to the tools or practices used to prevent or minimize human error is needed.

• Among issues other than above, 3 issues are related to the gap between management expectations and actual practice in the field, and they are counted in 2.3.1. The rest are related to control of access to SSCs, inappropriate reactivity management procedure, ineffective operator walk-down and ineffective surveillance programme.

• The only one good practice identified is related to the training which consists of dynamic learning activities.

2.3.5. Work authorizations

• Findings: one recommendation, 2 suggestions, no good practice

• No Trends

• The issues are regarding work control and authorization process, clearance requests and physical securing of isolating devices; however there are no trends on these findings.

2.3.6. Fire prevention and protection programme

• Findings: 10 recommendations, 6 suggestions, 2 good practices

<u>• Trend: In many plants, the fire prevention and protection programme is not strictly implemented. (15/19)</u>

Examples show that:
– Cable separation arrangements are inadequate.
– Implementation of maintenance and approved modifications are delayed.
– Storage of the combustible materials is inappropriate.
– A number of fire doors and ventilation flaps remain opened.
– Fire safety analysis is out of date.
– Fire barriers and penetrations are damaged.
– Fire prevention measures are not rigorously reviewed and applied for additional fire loads.
– Number of cigarette butts are found in smoking prohibited areas.

The fire prevention and protection programme should be regularly reviewed and improved.

• The issue other than above is that the qualified on-site fire brigade is not available at all times.

• There are two good practices which are related to fire load display system and drawings to manage fire zone deviations.

2.3.7. Management of accident conditions

• Findings: 2 recommendations, no suggestion, 3 good practices

• There are two issues related to incomprehensiveness of the severe accident management programme. Therefore, these 2 cases are counted in 2.14.

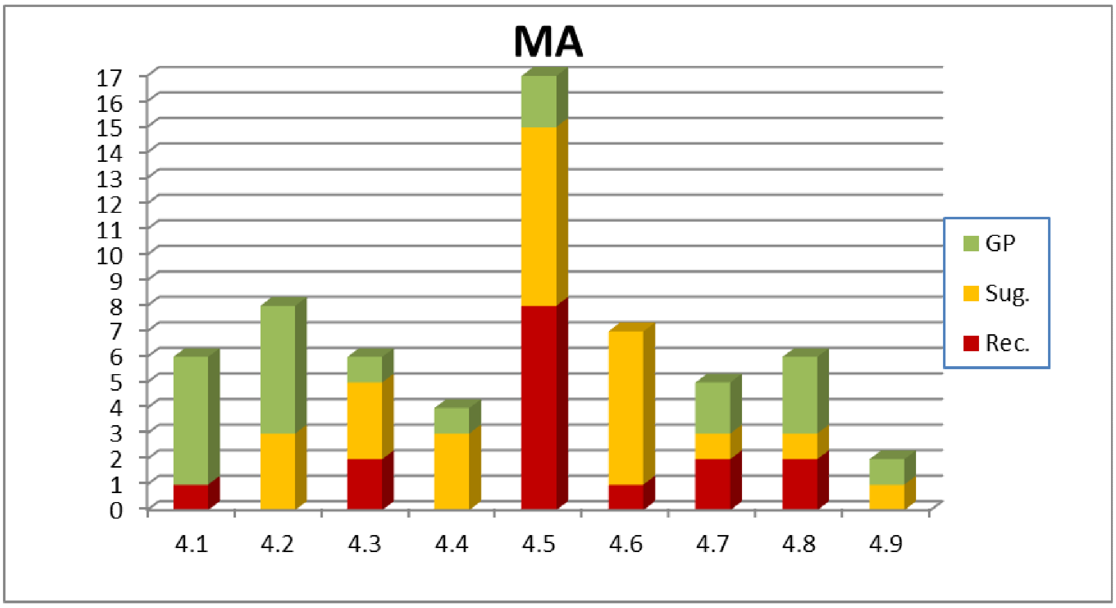
• Good practices are related to computerized method for monitoring EOP continuous actions, custom EOP for monitoring support functions and comprehensive system to address station blackout.

2.4. Maintenance

2.4.0. Summary of findings

The review of the MA area for the 19 plants resulted in 61 findings from which 16 are recommendations, 25 are suggestions and there are 20 good practices.
The distribution of the findings between the different topics of the MA review is presented below:

Title		Rec.	Sug.	GP	Total
4.1	Organization and functions	1	0	5	6
4.2	Maintenance facilities and equipment	0	3	5	8
4.3	Maintenance programmes	2	3	1	6
4.4	Procedures, records and histories	0	3	1	4
4.5	Conduct of maintenance work	8	7	2	17
4.6	Material conditions	1	6	0	7
4.7	Work control	2	1	2	5
4.8	Spare parts and materials	2	1	3	6
4.9	Outage management	0	1	1	2
Total		16	25	20	61



2.4.1. Organization and functions

• Findings: one recommendation, no suggestion, 5 good practices

• No trends

• The issue is that the plant maintenance policies are not specified in enough detail and the maintenance staff does not always meet plant requirements.

• The good practices are related to certification programme for maintenance work planner, safety culture training and coaching programme for contractors, supervisor training programme, maintenance corrective action review process and valve skill map for field workers

2.4.2. Maintenance facilities and equipment

• Findings: no recommendation, 3 suggestions, 5 good practices

• Trend: In a few plants, maintenance equipment is not well maintained in terms of the storage and calibration control. (2/19)

Examples show that:
– Tackle blocks are damaged.
– On many items of equipment, the appropriate calibration stamp is missing.
– There is a chain block suspended from a scaffold tube which is not a secure lifting point.

Without well maintained maintenance equipment, the quality of the maintenance of safety related equipment could be detrimentally affected.

• The other issue is related to material conditions, and counted in 2.4.6.

• The good practices are related to upgrading of safety systems by own staff, dedicated channel test equipment, testing facilities and mock-ups, pocket voltage detector and reduction of tritium uptake.

2.4.3. Maintenance programmes

• Findings: 2 recommendations, 3 suggestions, one good practice

• Trend: In a few plants, the maintenance programme is not fully effective in terms of clear criteria for and completeness of preventive programmes. (2/19)

Examples show that:
– Several equipment related to safety are missing in the preventive maintenance programme.
– For some of equipment, the criteria used for the predictive maintenance is not fully trended and communicated to all involved personnel.

The preventive and predictive maintenance programmes should be reinforced to ensure the reliability and safe operation of equipment.

• One of the 2 other issues is related to ageing management programme, and counted in 2.11. The other is related to maintenance work backlog management and counted in 2.4.7.

• The only good practice identified is related to monitoring of measuring circuit performance.

2.4.4. Procedures, records and histories

• Findings: no recommendation, 3 suggestions, one good practice

• Trend: In a few plants, the maintenance procedures are not always correct and comprehensive. (2/19)

Examples show that:

– The maintenance procedure for pumps does not require changing of bearings during overhaul maintenance and does not contain information how to reassemble bearings.
– Some procedures have missing information, such as basic steps, required tools or controls
– The procedure for assembly and adjustment of flanges does not exist.
– There is a contradiction between procedures.

Plants should consider providing correct and comprehensive maintenance procedures to ensure proper quality of all maintenance activities.

• The other issue is related to work order report.

• The good practice is usage of photos in working instructions.

2.4.5. Conduct of maintenance work

• Findings: 8 recommendations, 7 suggestions, 2 good practices

<u>• Trend: In some plants, the control of maintenance activities is insufficient that leads to unsafe work practice and behaviour. (8/19)</u>

Examples show that:
– During maintenance work on a valve, water leaks down to the floor without protection or water collection.
– Materials are temporarily stored near safety related equipment and could lead to damage of the equipment.
– The sling arrangement is inadequate during the lifting of a valve bonnet.
– There are a few facts of insufficient review of working places after the completion of work.

Improper maintenance practices and use of inappropriate maintenance tools could result in damage to safety equipment and injuries to personnel.

<u>• Trend: In some plants, the foreign material exclusion (FME) programme is not fully comprehensive and not consistently and effectively applied. (5/19)</u>

Examples show that:
– In a few cases FME areas are not properly designated or demarcated.
– Several equipment is found without FME protection.
– Some events due to the lack of FME are reported.
– In some cases tapes and other items are found in FME areas.

Intrusion of foreign materials can strongly jeopardize the plant safety. Therefore, the plants should reinforce their FME programmes to ensure strict implementation and practices throughout the organization including contractors.

• The other issue is related to improper work clearance orders.

• The good practices are related to tool for marking electrical worksites and armband for work leaders.

2.4.6. Material conditions

• Findings: one recommendation, 6 suggestions, no good practice

• Trend: In many plants, there is a need to improve their material conditions programmes and reinforce their implementation. (11/19 (including one issue identified in 2.4.2, 2.4.3, 2.4.5 and 2.5.1 respectively))

Examples show that:
– In a few plants, the programmes for elimination of small deficiencies in material conditions are not fully implemented or actions to eliminate deficiencies are not taken at all.
– In some cases, the reinforcement of different aspects of the programme such as identification, report, monitoring of condition and elimination of deficiencies is not sufficient.
– In a many cases, the cable trays are overloaded or not covered.
– In some cases, inadequate cable conditions and routing
– A number of oil and water leak conditions and missing labelling were observed.

The detailed review of this trend shows that most of the reviewed plants are more than twenty five years in operation and the trend may resulting from the material and structure aging.

Deficient material conditions could lead to deterioration of the equipment at the plant resulting in their unavailability. The plants should consider improving the overall material condition programme and its implementation.

2.4.7. Work control

• Findings: 2 recommendations, one suggestion, 2 good practices

• Trend: In a few plants, the work control process is not always efficient to ensure timely completion of maintenance works and prevent high number of backlogs. (2/19 (including one issue identified in 2.4.3))

Examples show that:
– A large maintenance backlog and inability of the existing system to identify them effectively.
– High number of work orders under execution exceeded their assigned date of completion.
– High number of backlogs for elective and preventive maintenance requests.

Untimely maintenance of the safety important systems may have significant implication on plant safe operation. Consideration should be given to improve work control process and enhance its effectiveness.

• The other issues are regarding maintenance and testing preparation and risk analysis prior to maintenance activities; however there is no trend on these findings.

• The good practices are related to comprehensive information system for work control and tag-out preparation software.

2.4.8. Spare parts and materials

• Findings: 2 recommendations, one suggestion, 3 good practices

• Trend: In a few plants, there are indications that plant policies for the timely supply and control of spare parts and hazardous materials are not followed. (3/19)

Examples show that:
– The procedure for storage and release of spare parts for equipment does not exist.
– The environmental condition in the main spare parts storage building is not controlled.
– Inadequate tagging of hazardous, flammable and fragile items.
– Improper segregation of safety related items from non-safety related and incomplete traceability of some safety related equipment.
– Station trending report shows a rise in Spares Unavailability trend code.

Inappropriate control of storage conditions and delays in their supply can compromise the high level of plant safety. Plants should consider improving existing practices and enhancement of the timely supply and control over the spare parts and hazardous materials.

• The good practices are automated shuttle storage unit, IT tool to connect maintenance and logistics departments and color coding of labels of spare parts and materials.

2.4.9. Outage management

• Findings: no recommendation, one suggestion, one good practice

• The issue is regarding control and monitoring of outage preparation.

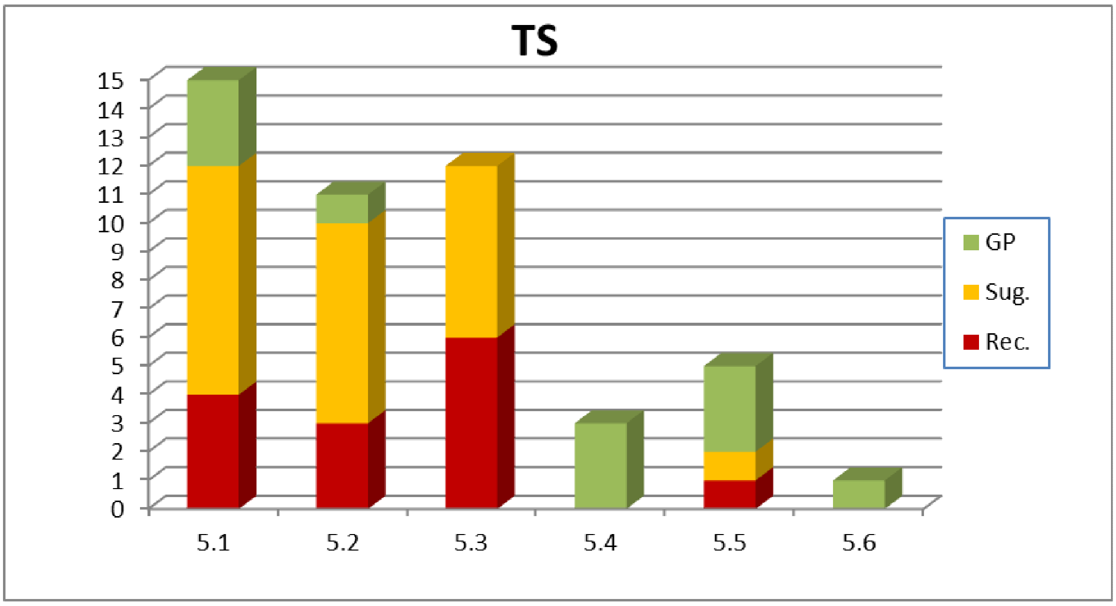
• The good practice is related to nuclear safety guidelines for outages.

2.5. Technical support

2.5.0. Summary of findings

The review of the TS area for the 19 plants resulted in 47 findings from which there are 14 recommendations, 22 suggestions and 11 good practices.
The distribution of the findings between the different topics of the TS review is presented below:

	Title	Rec.	Sug.	GP	Total
5.1	Organization and functions	4	8	3	15
5.2	Surveillance programme	3	7	1	11
5.3	Plant modification system	6	6	0	12
5.4	Reactor core management (reactor engineering)	0	0	3	3
5.5	Handling of fuel and core component	1	1	3	5
5.6	Computer based systems important to safety	0	0	1	1
	Total	14	22	11	47



2.5.1. Organization and functions

• Findings: 4 recommendations, 8 suggestions, 3 good practices

<u>• Trend: In a few plants, the plant specific probabilistic safety analysis (PSA) model is not sufficiently developed and not fully utilized as a tool for operational decision making. (2/17)</u>

Examples show that:
– There is only a limited PSA model e.g. not fully developed model for shutdown mode and not including fire PSA etc.
– The plant PSA model is not regularly updated to allow understanding plant vulnerabilities and optimizing the implementation of the defence in depth concept.
– The insights provided by PSA are used in limited areas.

Plants should develop and regularly update the plant specific PSA model and utilise it in the safety related activities to minimize the risk.

Nevertheless, the OSART team also found a good practice in this area where a high quality and comprehensive PSA, with state-of-art methods and tools, is continuously and extensively used by the plant in several areas.

• Trend: In a few plants, the plant safety analysis report does not reflect the current plant status. (2/19)

Examples show that:
– The scope of safety analysis report does not fully meet the IAEA safety guide GS-G-4.1.
– The plant safety analysis report is not regularly updated and the current plant status is not reflected.

Plants should keep the safety analysis report updated, so that the report can fulfill its purpose as the licensing basis of the plant.

• Trend: In a few plants, the periodic safety review (PSR) is not sufficient in terms of scope, duration and frequency. (2/19)

Examples show that:
– The duration from the start and finalization of the PSR is more than ten years.
– The plant does not undertake PSRs in accordance with the frequency established by the IAEA safety standards, namely about ten years after the start of the plant and subsequent every ten years.
– The plant does not carry out the PSR covering the scope established in the IAEA safety standards.

Plants should implement comprehensive PSRs covering all safety factors in a timely manner. Otherwise, there is a potential for plants to fall behind improving international safety standards, and suffer unexpected consequences from cumulative effects.

• Trend: In a few plants, operational controls to minimise damage due to a seismic event are not consistently applied. (2/19 (including one issue identified in 2.5.3))

Examples show that:
– Hoisting chains are hanging very close to valves included in the safety system.
– Several trolleys and carts are found in the reactor hall without their brakes.
– Some equipment was found unrestrained.

Without implementing the proper seismic housekeeping standards, the performance of safety systems could be adversely affected in a seismic event.

• Two issues are related to performance indicators, and counted in 2.1.2. One of the other issues is related to material conditions, and counted in 2.4.6. The rest are related to equipment qualification programme and plant system health management.

• The other good practices identified in this area are related to knowledge transfer and training programme.

2.5.2. Surveillance programme

• Findings: 3 recommendations, 7 suggestions, one good practice

• Trend: In a few plants, the plant surveillance programme is not sufficiently developed, implemented and evaluated. (6/19)

Examples show that:
– Trending of surveillance results is not systematically carried out.
– Some surveillance testing of safety related equipment is not being performed in accordance with the required periodicity.
– The surveillance testing by functional checks does not address all possible failure modes and appropriate tests are not recognized as part of the surveillance testing in some cases.
– No formal requirements for surveillance programme evaluation are set.

In order to ensure safe and reliable operation of all SSCs, and their availability at all times to perform dedicated functions, a comprehensive plant surveillance programme should be in place at the NPP and its implementation should be assured.

• One of the other issues is related to ageing management programme, and counted in 2.11. The rest are related to measurement of confinement and equipment operability and hazard assessment.

• The good practice is related to measurements of internal and external diameters of reactor vessel flange.

2.5.3. Plant modification system

• Findings: 6 recommendations, 6 suggestions, no good practice

• Trend: In some plants, the management of temporary modifications is not adequately performed. (6/19)

Examples show that:
– High numbers of temporary modifications are in place and which are not resolved in a timely manner.
– A comprehensive list of temporary modifications at the plant is not available or only reviewed annually.

Plants should reinforce the control of temporary modifications to maintain plant safety throughout the plant lifetime according to design.

• Trend: In some plants, different elements of the modification process, such as modification categorization, human factor consideration, documentation update and modification control should be enhanced. (5/19)

Examples show that:
– Several non-registered modifications were found.
– The process of review of status of modifications is not formalized and systematic.

– Human factor evaluations of tasks before and after modifications were not routinely carried out.
– Changes following modifications were not introduced in the respective documentation prior to operation.
– Plant modifications were not identified and closed in a timely manner.

Plants should review and enhance all elements of the modification process to ensure that modifications performed do not compromise the safety of the nuclear facility.

• The remaining issue is related to seismic housekeeping standards, and counted in 2.5.1.

2.5.4. Reactor core management (Reactor engineering)

• Findings: no recommendation, no suggestion, 3 good practices

• The good practices are related to support for industry effort to improve fuel design, guide on preparation of power reduction transients and independent testing of fresh fuel enrichment.

2.5.5. Handling of fuel and core components

• Findings: one recommendation, one suggestion, 3 good practices

• No trends

• The issues are regarding fuel management process and management of documents related to fuel movements; however, there is no trend on these findings.

• The good practices are related to pocket book for fuel handling, fuel condition recording equipment and fuel casks with shock indicators.

2.5.6. Computer based systems important to safety

• Findings: no recommendation, no suggestion, one good practice

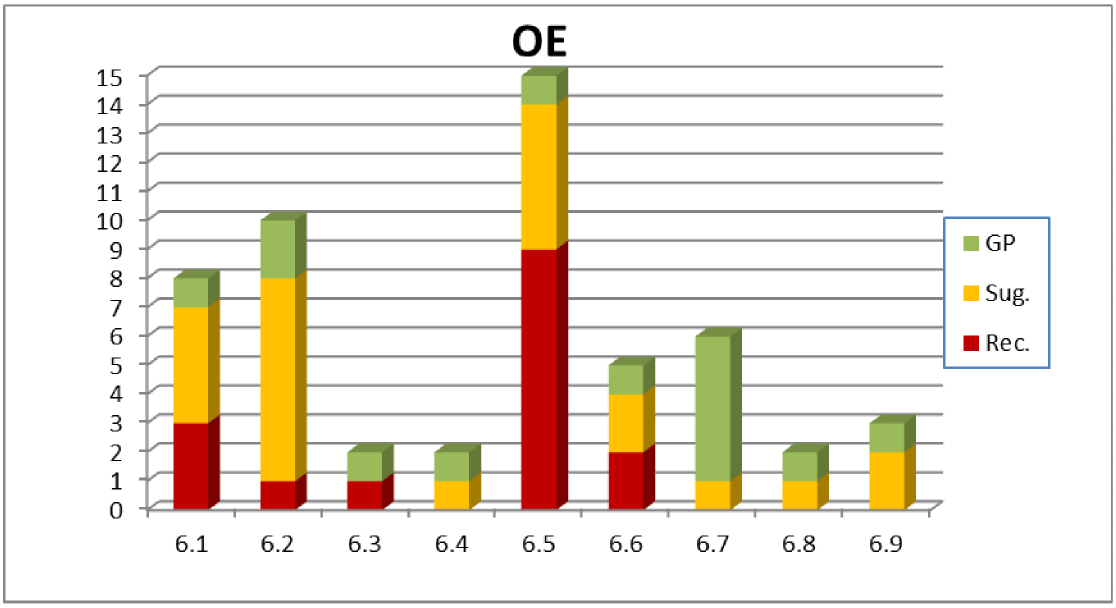
• The good practice is related to Reactor Coolant System leak rate calculation system that provides for identification of adverse trends.

2.6. Operational experience feedback

2.6.0. Summary of findings

The review of the OE area resulted in 53 findings from which there are 16 recommendations, 23 suggestions and 14 good practices.
The distribution of the findings between the different topics of the OE review is presented below:

Title		Rec.	Sug.	GP	Total
6.1	Management, organization and functions of the OE program	3	4	1	8
6.2	Reporting of operating experience	1	7	2	10
6.3	Sources of operating experience	1	0	1	2
6.4	Screening of operating experience information	0	1	1	2
6.5	Analysis	9	5	1	15
6.6	Corrective actions	2	2	1	5
6.7	Use of operating experience	0	1	5	6
6.8	Data base and trending of operating experience	0	1	1	2
6.9	Assessments and indicators of operating experience	0	2	1	3
Total		16	23	14	53



2.6.1. Management, organization and functions of the OE program

• Findings: 3 recommendations, 4 suggestions, one good practice

<u>• Trend: In some plants, the operating experience programmes are not sufficiently developed and effectively implemented to enhance operational safety. (7/19 (including one issue identified in 2.6.6))</u>

Examples show that:
– The plant management policy lacks specific information related to the use of OE feedback.
– Corrective actions are not prioritized according to the significance of safety.

– The OE feedback process is not optimized. (separate databases, fragmented organization for OE).
– The evaluation of the effectiveness of the OE programme is not systematically performed.

A comprehensive and optimized OE programme should be developed and implemented.

• The other issue is that review of internal OE is not resulted in timely corrective actions.

• The good practice is related to corrective action review committee.

2.6.2. Reporting of operating experience

• Findings: one recommendation, 7 suggestions, 2 good practices

• Trend: In some plants, low level events (LLEs) and near misses (NMs) are not reported in a systematic and consistent manner. (7/19)

Examples show that:
– The threshold for reporting LLEs and NMs at the plant is not clearly specified or sufficiently low.
– There is no formal and refresher training provided to the plant personnel including contractors.
– Defects which are immediately corrected during the plant tour by management are not consistently reported.

A comprehensive, systematic and integrated low level events and near miss reporting programme should be developed by the plants.

• The other issue is related to reporting to international organizations.

• The good practices are related to healthy reporting culture and good catch programme.

2.6.3. Sources of operating experience

• Findings: one recommendation, no suggestion, one good practice

• The issue is that external OE is not screened in a timely and comprehensive manner.

• In contrast, there is one good practice regarding the structured process of screening and analyzing of external OE.

2.6.4. Screening of operating experience information

• Findings: no recommendation, one suggestion, one good practice

• The issue is regarding the screening process of LLEs and NMs.

• The good practice in this area is related to effective use of pictures in LLEs and NMs reporting and screening.

2.6.5. Analysis

• Findings: 9 recommendations, 5 suggestions, one good practice

<u>• Trend: In some plants, the root cause analysis is not effective enough to prevent the recurrence of events. (6/19)</u>

Examples show that:
– Some analysis of events does not go up to identification of the barriers.
– No dedicated specialist in investigation of human and organizational factor is involved in the root cause analysis.
– There is no requirement for retraining of the event investigators for root cause analysis.

The root cause analysis should be improved in order to systematically identify root causes and other learning opportunities.

<u>• Trend: – In some plants, the event analysis is not timely performed to the required depth and rigor. (5/19)</u>

Examples show that:
– The analysis of low level events does not identify the origin of the deficiencies.
– Significant event reports do not clearly indicate what investigation method or combination of methods was used and do not always contain reference data.
– No corrective actions are determined from analysis of LLEs and NMs.
– Except reportable events, on average, time to start and /or to complete an analysis is relatively long.

The plants should perform thorough and timely analysis of the significant events, LLEs and NMs to effectively identify most beneficial corrective actions and timely implement them.

• The other issues are related to delay of analysis and un-integrated LLE database. One issue is related to corrective action programme, and counted in 2.6.6.

• The good practice is related to strategy of increasing the number of investigated LLEs and NMs.

2.6.6. Corrective actions

• Findings: 2 recommendations, 2 suggestions, one good practice

<u>• Trend: In a few plants, the corrective action programme is not robust enough. (3/19 (including one issue identified in 2.6.5))</u>

Examples show that;
– Effectiveness reviews are not performed on closed corrective actions.
– There is no procedure to review the effectiveness of corrective actions.
– Corrective actions are spread out in various databases, which make it difficult to perform an integrated trend analysis.

Ineffective corrective actions could result in recurrence of events thus impacting the safety of the plant.

One issue is related to the effectiveness of OE programme, and counted in 2.6.1. The other issue is related to untimely closure of corrective actions.

The good practice is related to management of corrective actions in a manner that enhance their effective implementation.

2.6.7. Use of operating experience

• Findings: no recommendation, one suggestion, 5 good practices

• No trends

• The issue is regarding the accessibility to OE information.

• Adversely, the OE webpage which enables all station staff to access easily to the detailed OE information is identified as a good practice. The other good practices are related to tool for motivating staff, ergonomic assessment of working places in main control room, handbook describing overview of events and quick response to external OE.

2.6.8. Data base and trending of operating experience

• Findings: no recommendation, one suggestion, one good practice

• The issue is regarding tracking and trending of LLEs and corrective actions.

• The good practice is related to online event database.

2.6.9. Assessments and indicators of operating experience

• Findings: no recommendation, 2 suggestions, one good practice

<u>• Trend: In a few plants, the effectiveness of the Operating Experience (OE) programme is not sufficiently assessed. (2/19)</u>

Examples show that:
– No guidance document on how and when to conduct self-assessment of OE programme exists.
– External OE is not covered in self –assessment of OE programme.
– Key indicators such as “the number of recurrent events, number and age of reports awaiting evaluation etc.” are not used in tracking the effectiveness of the OE process.

A consistent and systematic monitoring, evaluation and self-assessment programme and performance indicators for the measurement of the overall OE process effectiveness should be established.

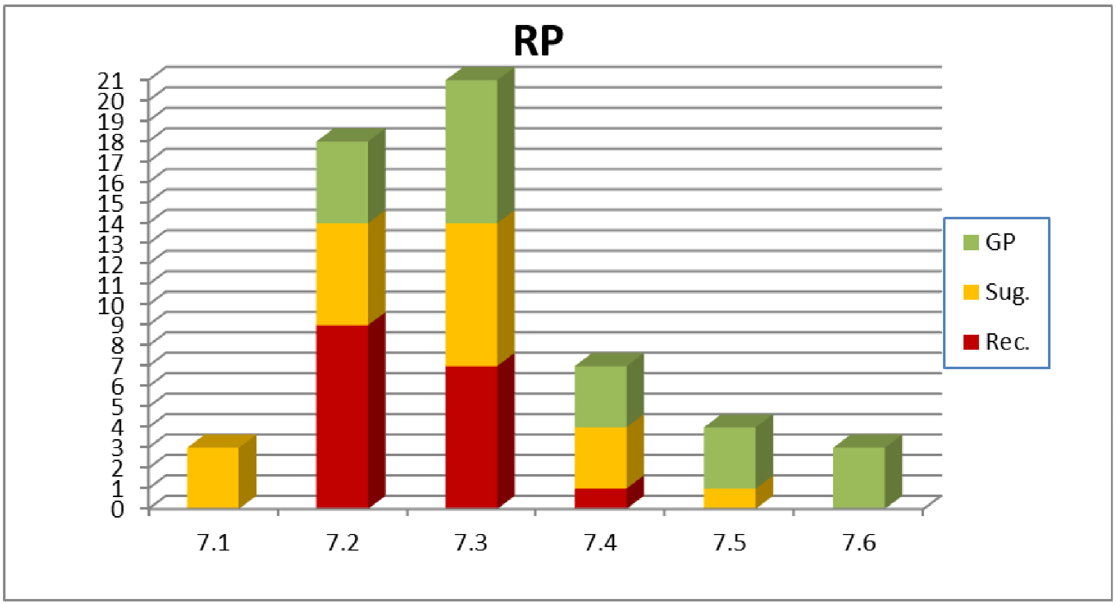
• The good practice is related to self-assessment exercises.

2.7. Radiation protection

2.7.0. Summary of findings

The review of the RP area in the 19 visited plants resulted in 56 findings from which there are 17 recommendations, 19 suggestions and 20 good practices.
The distribution of the findings between the different topics of the RP review is presented below:

Title		Rec.	Sug.	GP	Total
7.1	Organization and functions	0	3	0	3
7.2	Radiation work control	9	5	4	18
7.3	Control of occupational exposure	7	7	7	21
7.4	Radiation protection instrumentation, protective clothing and facilities	1	3	3	7
7.5	Radioactive waste management and discharges	0	1	3	4
7.6	Radiation protection support during emergencies	0	0	3	3
Total		17	19	20	56



2.7.1. Organization and functions

• Findings: no recommendation, 3 suggestions, no good practice

• No trend

The issues are regarding repair and testing of radiation monitors, radiological administrative limits, use of performance indicators, health surveillance and investigation levels system; however there is no trend on these findings.

2.7.2. Radiation work control

• Findings: 9 recommendations, 5 suggestions, 4 good practices

• Trend: In many plants, contamination control practices and measures for preventing the spread of contamination are not comprehensive and sufficient in the field. (13/19 (including 6 issues identified in 2.7.3 and one issue identified in 2.7.4)).

Examples are as follows:
– Personal items are not always measured when exiting the Radiation Controlled Area (RCA).
– There is no contamination monitoring equipment at exit points from low level contamination areas.
– Contamination monitors are not sufficiently efficient e.g. not sensitive enough to detect contamination on RCA clothing, the distance between body and detectors is not determined, functional testing is carried out only quarterly or annually.
– Personal contamination events at the exit from the RCA are not always reported and analysed.
– Individuals were observed not using personal protective equipment correctly.
– There is no evidence of written investigations of contamination spreads, personal or equipment contaminations, except when regulator report is required.
– Radioactive waste containers which are potentially contaminated are not labelled.

Comprehensive procedures and fully implemented measures can ensure control of contamination and prevent the spread of contamination.

• Trend: In some plants, radiological work permit (RWP) does not always include appropriate information or is not fully followed by the plant personnel. (4/19)

Examples show that:
– There is no written radiological work permit (RWP) to give controls for radiological work.
– Different units are used on RWP and the digital dosimeter.
– Appropriate written instructions are not provided to radiation workers to ensure their safety.
– There are several events of individuals exceeding dose rate alarm level due to the entering into the area not covered under RWP.

Without clear instructions and understanding of radiological conditions, radiation exposures and personnel contamination could be challenged.

• The other issues are related to physical barriers, radiation posting and signage, material transfers and ALARA in radiography testing.

• Good practices have been identified in-situ gamma spectroscopy to determine activity concentrations on internal surfaces of primary coolant and auxiliary systems component, index cards describing radiation protection measures, display system of RP information and so on.

2.7.3. Control of occupational exposure

• Findings: 7 recommendations, 7 suggestions, 7 good practices

• Trend: In some plants, measures and arrangements undertaken to further reduce the exposure of individuals are insufficient. (4/19).

Examples show that:
– The performance indicator goal for individual annual dose is not challenging enough.
– The ALARA plan is not comprehensive enough to reduce low level radiation exposure.
– The administrative individual dose limit for plant staff is not applied to contractors.
– There is no formal mechanism for reporting on progress of the dose reduction techniques.

The plants should consider to further increasing efforts to reduce the exposure of individuals as low as reasonably achievable.

• 6 issues other than above are related to contamination control, and counted in 2.7.2. The rest are planning, setting dose constraints and reviewing performance, ineffective monitoring, control of radiation hazards and neutron dose assessment.

• 7 good practices identified in this area aimed towards the reduction of radiation exposure, but all by different means. The means include training of proper use of protective clothing, automated TLD issue system, dose reduction techniques for handling neutron sources and so on.

2.7.4. Radiation protection instrumentation, protective clothing and facilities

• Findings: one recommendation, 3 suggestions, 3 good practices

• No trends

• One of the issues is regarding the contamination control and counted in 2.7.2. Other 3 issues are regarding the access control to the irradiation room, the initial source check and the storage of radioactive materials and waste.

• However 3 good practices have been identified, which were the use of low power mobile phones in the RCA, sophisticated cabinet for key management and the system that ensure the dose rate measurement at a precise distance.

2.7.5. Radioactive waste management and discharges

• Findings: no recommendation, one suggestion, 3 good practices

• No trends

• The only issue identified is that onsite and offsite radiation monitoring is not always sufficiently performed.

• 3 good practices have been identified, which were the well-established environment programme, radioactive waste management programme and special shielded transport container for waste with high dose rate.

2.7.6. Radiation protection support during emergencies

• Findings: no recommendation, no suggestion, 3 good practices

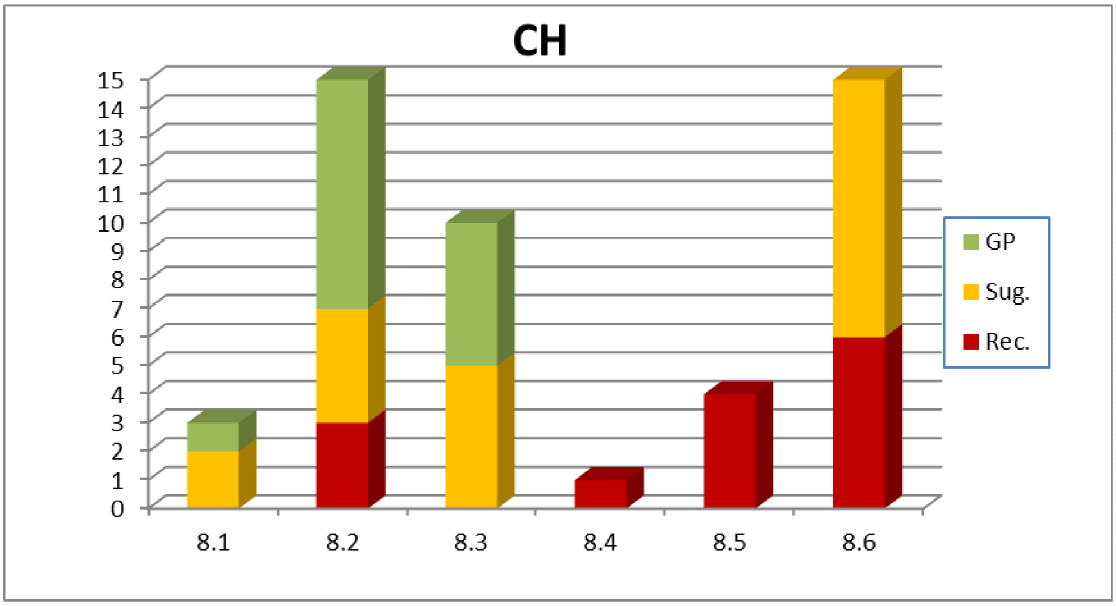
• The good practices are related to emergency monitoring vehicles, monthly emergency training for RP shift personnel and automated aerological probing system.

2.8. Chemistry

2.8.0. Summary of findings

The review of the CH area in the 19 visited plants resulted in 48 findings from which there are 14 recommendations, 20 suggestions and 14 good practices.
The distribution of the findings between the different topics of the CH review is presented below:

Title		Rec.	Sug.	GP	Total
8.1	Organization and functions	0	2	1	3
8.2	Chemistry control in plant systems	3	4	8	15
8.3	Chemical surveillance programme	0	5	5	10
8.4	Chemistry operational history	1	0	0	1
8.5	Laboratories, equipment and instruments	4	0	0	4
8.6	Quality control of operational chemicals and other substances	6	9	0	15
Total		14	20	14	48



2.8.1. Organization and functions

• Findings: no recommendation, 2 suggestions, one good practice

• No trends

• The issues are related to the equipment calibration and checking with standard solutions and ineffectiveness of performance indicators.

• The good practice is related to the training of the chemistry staff.

2.8.2. Chemistry control in plant systems

• Findings: 3 recommendations, 4 suggestions, 8 good practices

• Trend: In some plants, the chemistry control programmes are not sufficiently comprehensive to identify, trend and minimize corrosion processes and deal with all chemistry aspects of safety related systems. (6/19 (including one issue identified in 2.8.3))

Examples show that:
– In the primary circuit during operation, oxygen concentration is not measured.
– Impurities such as chlorides and sulfates in reagents that are added to the primary and secondary circuit are not analysed.
– The monitoring of corrosion process in plant systems is not sufficiently comprehensive.
– The chemical control programme for the emergency diesel generators and other emergency systems is not comprehensive.
– Corrosion process, corrosion product transport and radioactivity build-up are not properly controlled and minimized.

The plants should enhance the chemistry control programme to deal with all chemistry aspects of safety related systems which may have an adverse impact on these systems.

• The other issues are related to updating of procedures and software and ineffective use of on-line monitors.

• 8 good practices have been identified which were reduction of liquid waste, fuel leaker identification using alpha-spectrometry, chemistry control of the secondary side of SGs during shutdown modes and so on. However, no trends were found.

2.8.3. Chemistry surveillance programme

• Findings: no recommendation, 5 suggestions, 5 good practices

• No trends

• There is one issue regarding the incomprehensiveness of the chemistry control programme and that is counted in 2.8.2. Other issues are related to chemistry QC and QA programmes, absence of the tool to manage, evaluate and trend chemical data, inadequate on-line monitoring systems and so on.

• 5 good practices have been identified as well. They are regarding ISO based QA in laboratories, system for the optimization of sample plans, training to reduce dose and human errors and so on.

2.8.4. Chemistry operational history

• Findings: one recommendation, no suggestion, no good practice

• No trends

• The issue is regarding chemical excursions due to inappropriate operational and maintenance practices.

2.8.5. Laboratories, equipment and instruments

• Findings: 4 recommendations, no suggestion, no good practice

• Trend: In a few plants, the operability of the liquid and gaseous post-accident sampling system and methods are not properly ensured. (2/19)

Examples show that:
– Methods for obtaining, transporting and analyzing samples are not defined.
– Exercises and drills on simulated operation of the system are not performed.
– The operability of the system is not periodically tested and maintained.
– The system does not have the capability to dilute liquid and gaseous samples.
– The syringe for obtaining samples does not have adequate shielding to decrease exposure.

Post-accident sampling methods, training, engineering support, maintaining and periodical testing activities should be improved in order to ensure operability of the system.

• One of the other issues is related to improper storage of chemicals, and counted in 2.8.6. The rest is the issue related to conditions in the hot laboratories.

2.8.6. Quality control of operational chemicals and other substances

• Findings: 6 recommendations, 9 suggestions, no good practice

• Trend: In many plants, the quality control of operational chemicals and other substances is not appropriate. As a consequence, the procedures for management of chemicals (for example purchase, storage and labelling) are not sufficiently implemented. (14/19 (including one issue identified in 2.8.5))

Examples show that:
– A list of chemicals allowed to be used in the controlled area is not available.
– A well-structured and comprehensive process does not exist for quality control of operational chemicals and other substances.
– There is no full implementation of procedure for clear definition and categorization of operational chemicals and other substances in the field.
– Hazardous chemicals are not stored in a locked box.
– Some chemicals are not labelled or incorrectly labelled.
– Batteries are stored together with chemicals in a cabinet.
– Ventilation in the laboratory chemicals storage is out of service.
– Shelf life and expiration dates of chemicals are not provided in many cases.

Plants should establish and implement a well-structured, integrated and comprehensive process for purchase, storage and quality control of operational chemicals and other substances in order to avoid potential risk of improper use, personal injury and have detrimental effects on safety system components. The management of chemicals should be established to ensure that industrial safety protection is provided to the personnel regarding the labelling of chemicals, availability of equipment and safety information.

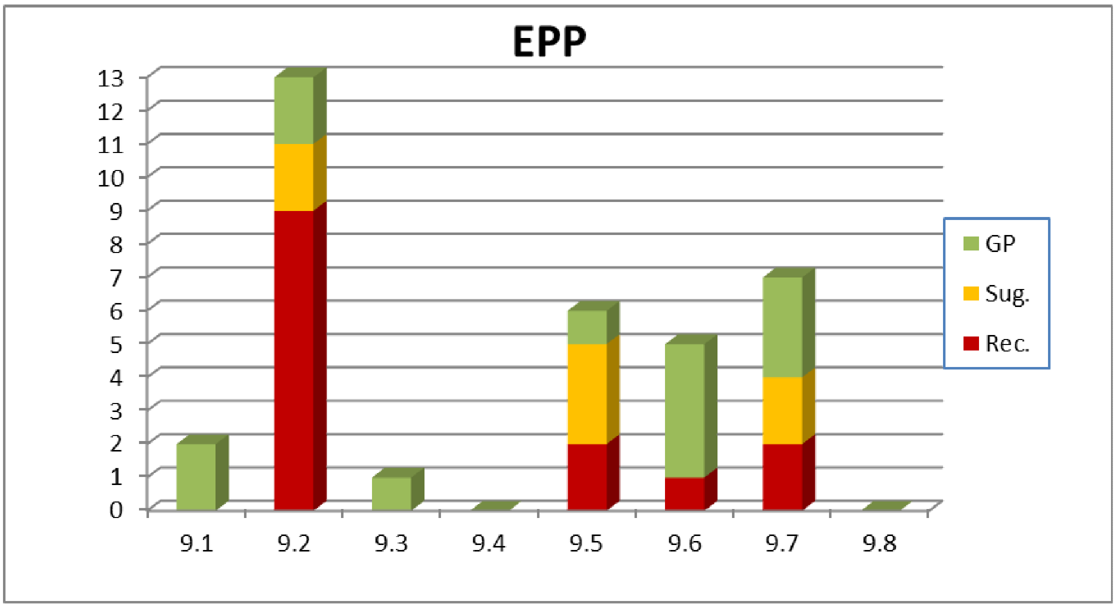
• The other issues are related to improper trending of chemistry results from diesel fuel analysis and criteria and parameters to monitor the resin performance.

2.9. Emergency planning and preparedness

2.9.0. Summary of findings

The review of the EPP area in the 15 visited plants resulted in 34 findings from which there are 14 recommendations, 7 suggestions and 13 good practices.
The distribution of the findings between the different topics of the EPP review is presented below:

Title		Rec.	Sug.	GP	Total
9.1	Emergency programme	0	0	2	2
9.2	Response functions	9	2	2	13
9.3	Emergency plans and organization	0	0	1	1
9.4	Emergency procedures	0	0	0	0
9.5	Emergency response facilities	2	3	1	6
9.6	Emergency equipment and resources	1	0	4	5
9.7	Training, drills and exercises	2	2	3	7
9.8	Quality assurance	0	0	0	0
Total		14	7	13	34



2.9.1. Emergency programme

• Findings: no recommendation, no suggestion, 2 good practices

<u>• Trend: In a few plants, there is strong support for the public to be effectively prepared for an emergency. (2/15, Good practice)</u>

Examples show:
– The plant provides a calendar to the public which contains pre-defined forms to be used to provide the most important preliminary information (how many persons are expected to evacuate, if there are disabled in the household, communication means that can be used to contact etc.) to the authorities to support effective evacuation.

– The plant has an educational bus that visits local communities to teach both school children and adults about the activities that take place on the plant and the actions that they should take in the event of an emergency declaration.
– Members of the civic safety committee organized by local authority are authorized to enter the plant to access documents and discuss issues with plant personnel.
- The members of committee report that the plant is open in sharing all information with the public, important for their preparation for emergencies.

Detailed preliminary information on the response to an emergency should be provided to the public for the effective protective actions.

2.9.2. Response functions

• Findings: 9 recommendations, 2 suggestions, 2 good practices

• Trend: In some plants, there is no individual person on-site around the clock with the authority and responsibility to initiate the on-site emergency plan and notify the appropriate off-site authorities. (4/15)

Examples show:
– The site emergency director, who is authorized to initiate the on-site emergency plan, is only present at the plant during office hours.
– The authority is not fully delegated to the person such as the shift supervisor who is always on the site.
– There is no person 24 hours a day at the plant who is authorized to classify a nuclear emergency.

Without such an arrangement, unnecessary delays in implementing the emergency response could be caused.

• Trend: In some plants, the protection of emergency workers and evacuees in an emergency situation is not fully effective. (7/15 (including 2 issues identified in 2.9.5))

Examples show:
– Emergency facilities which are required to be manned during an emergency are not equipped with any personal protection equipment such as electronic dosimeters, respiratory protection and effective protective clothing.
– Emergency facilities are not continuously monitored in terms of radiation levels.
– Potassium iodine for the potential numbers of contractors and visitors outside the protected area are not available.
– Emergency evacuation routes are not clearly marked or blocked by obstacles.

Ineffective arrangements for the protection of persons on the site could cause unjustified health risks.

• The other issues are related to the unclear expectations for timelines of emergency responses and lack of appropriate joint agreement with off-site fire brigade.

• There are 2 good practices regarding robust, diversified and redundant telecommunication means deployed in the on-site emergency response facilities and computerized emergency decision support system.

2.9.3. Emergency plans and organization

• Findings: no recommendation, no suggestion, one good practice

• The good practice is related to the arrangement for the site evacuation.

2.9.4. Emergency procedures

• No findings

2.9.5. Emergency response facilities

• Findings: 2 recommendations, 3 suggestions, one good practice

• No trends

• There are 2 issues related to the insufficiency of facilities in terms of the protection of the plant personnel and they are counted in 2.9.2. Other 3 issues are regarding capabilities of emergency response centre, preparation of emergency response organization to deal with beyond design basis event and improper location of the public information centre.

• The good practice is related to the external emergency storage facility.

2.9.6. Emergency equipment and resources

• Findings: one recommendation, no suggestion, 4 good practices

• Trend: In a few plants, field monitoring data transmission system is developed. (2/15, Good practice)

Examples show:

– In a plant, radiation monitoring vehicles are equipped with a gamma dose rate system connected with GPS system allowing the emergency response centre to track their real-time locations and monitoring results. Real-time ambient dose rate values from 29 off-site gamma-tracer stations are also available on this system.

– The plant has a web-based programme to record and transmit the monitoring data from the field to the emergency response centre.

These systems can support the early and appropriate decision making on on-site and off-site emergency response.

• Only one issue is identified regarding conditions of emergency facilities, equipment and instrumentation.

• There are 2 good practices other than that shown above. They are related to Comprehensive database of emergency equipment and integrated information system in the emergency response centre.

2.9.7. Training, drills and exercises

• Findings: 2 recommendations, 2 suggestions, 3 good practices

• Trend: In some plants trainings, drills and exercises are not comprehensive and do not cover real emergency conditions. (4/15)

Examples show:
– The exercises of taking samples and carrying out dose rate measurements are not performed under realistic severe accident conditions.
– The scope of internal exercises is limited, and the remote emergency centre is not included in the exercise schedule.
– The frequency of joint exercises with off-site organizations is once per 5 years, the requirements for participation are not clearly defined.
– The plant has no separate list of response functions for the review of the exercise programme.

Plants should improve regular trainings, drills and exercises under realistic conditions that are essential for the effective operation of the response organization.

• 3 good practices are also identified. They are related to the cooperation with local police, customized training programme for each person in key emergency response positions and special training for the personnel who are in charge of management of on-site emergency organization.

2.9.8. Quality assurance

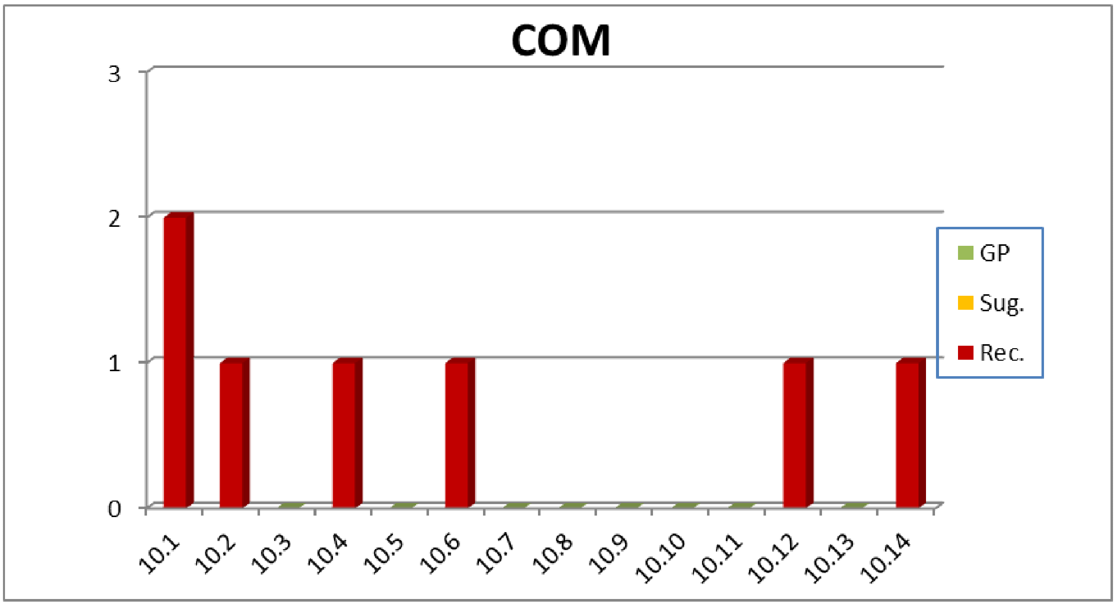
• No findings

2.10. Commissioning

2.10.0. Summary of findings

The review of the COM area in one visited plant resulted in 7 findings from which there are 7 recommendations, no suggestion and no good practice.
The distribution of the findings between the different topics of the COM review is presented below:

Title		Rec.	Sug.	GP	Total
10.1	Organization and functions	2	0	0	2
10.2	Commissioning programme	1	0	0	1
10.3	Training in commissioning	0	0	0	0
10.4	Preparation and approval of test procedures	1	0	0	1
10.5	Control of test and measuring equipment	0	0	0	0
10.6	Conduct of tests and approval of test results	1	0	0	1
10.7	Maintenance during commissioning	0	0	0	0
10.8	Interface with operations	0	0	0	0
10.9	Interface with construction	0	0	0	0
10.10	Interface with engineering (designer)	0	0	0	0
10.11	Initial fuel loading	0	0	0	0
10.12	Plant handover	1	0	0	1
10.13	Work control and equipment isolation	0	0	0	0
10.14	Control of temporary modifications	1	0	0	1
Total		7	0	0	7



2.10.1. Organization and functions

• Findings: 2 recommendations, no suggestion, no good practice

• There is one issue that commissioning management did not clearly communicate and re-enforce operational standards and expectations. The other is regarding the lack of monitoring of activities needed to exceed a safety milestone.

2.10.2. Commissioning programme

• Findings: one recommendation, no suggestion, no good practice

• There is one issue regarding the schedule and criteria of taking over from the constructor to the operator.

2.10.3. Training in commissioning

• No findings

2.10.4. Preparation and approval of test procedures

• Findings: one recommendation, no suggestion, no good practice

• There is one issue regarding the lack of a systematic independent assessment of commissioning and operational activities.

2.10.5. Control of test and measuring equipment

• No findings

2.10.6. Conduct of tests and approval of test results

• Findings: one recommendation, no suggestion, no good practice

• The issue is that safety assessments are not systematically applied on safety-related activities.

2.10.7. Maintenance during commissioning

• No findings

2.10.8. Interface with operations

• No findings

2.10.9. Interface with construction

• No findings

2.10.10. Interface with engineering (designer)

• No findings

2.10.11. Initial fuel loading

• No findings

2.10.12. Plant handover

• Findings: one recommendation, no suggestion, no good practice

• There is one issue regarding the lack of common, agreed standards in several areas.

2.10.13. Work control and equipment isolation

• No findings

2.10.14. Control of temporary modifications

• Findings: one recommendation, no suggestion, no good practice

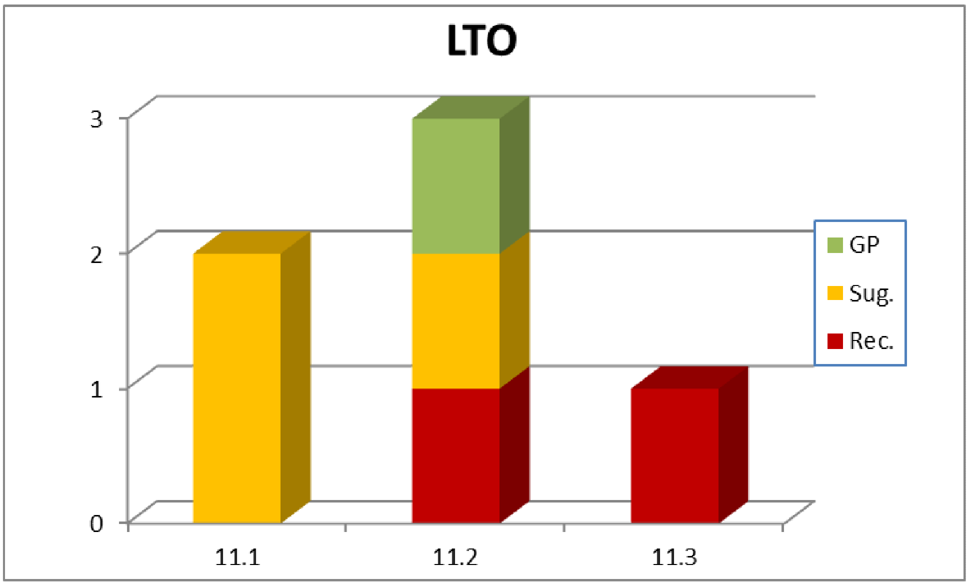
• The issue is that temporary modifications were not systematically implemented according to the plant's procedural guidelines.

2.11. Long term operation

2.11.0. Summary of findings

The review of the LTO area in 2 visited plants resulted in 6 findings from which there are 2 recommendations, 3 suggestions and one good practice.
The distribution of the findings between the different topics of the LTO review is presented below:

	Title	Rec.	Sug.	GP	Total
11.1	Organization and functions for LTO	0	2	0	2
11.2	Review of ageing management programmes	1	1	1	3
11.3	Revalidation of safety analyses that used time limited assumptions	1	0	0	1
	Total	2	3	1	6



2.11.1. Organization and functions for LTO

• Findings: no recommendation, 2 suggestions, no good practice

<u>• Trend: In a few plants, the ageing management programme is not comprehensive and scoping of SSCs for LTO is not complete. (4/19 (including issues identified in in 2.4.3, 2.5.2 and 2.11.2))</u>

Examples show:
– Ageing management programme is at the pilot stage.
– Ageing management programme do not contain all required generic attributes.
– There is no overall list of SSCs in a scope for LTO in an equipment master list.
– Methodology for creating the list of SSCs is not comprehensive (e.g. criteria are very general, no procedure for analysis of an SSC to determine if it meets the criteria).
– Several reportable events were due to equipment ageing.

Without a comprehensive ageing management programme and complete scope of SSCs for LTO, ageing management review does not cover all SSCs which may cause malfunctions or failures in the LTO period due to their ageing.

• The other issue is that programmes, documents and procedures for LTO are not complete.

2.11.2. Review of ageing management programmes

• Findings: one recommendation, one suggestion, one good practice

• No trend

• One issue is that the validity of equipment qualification was limited to design life and was not appropriate for LTO, and counted in 2.11.3. The other is that ageing management programmes (AMP) did not contain necessary AMP attributes, and counted in 2.11.1.

The good practice is related to strategy to manage the shroud cracking.

2.11.3. Revalidation of safety analyses that used time limited assumptions

• Findings: one recommendation, no suggestion, no good practice

<u>• Trend: In a few plants, Equipment Qualification (EQ) is limited or not completely revalidated for LTO. (2/19 (including one issue identified in 2.11.2))</u>

Examples show:
– The assessment for EQ is only valid until the end of original Plant design life.
– Qualification of original safety control cables was not revalidated for LTO.

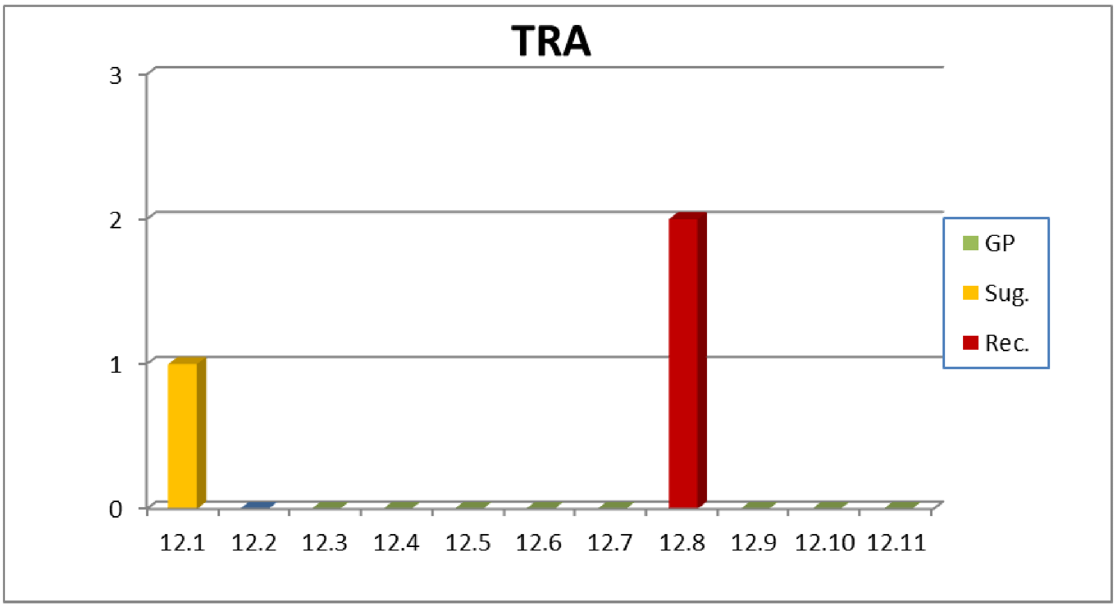
Without revalidation of qualified life time, it cannot be demonstrated that safety systems will perform their intended safety functions. Considerations should be given to reevaluating equipment qualification for LTO.

2.12. Preparedness for transition from operations to decommissioning

2.12.0. Summary of findings

The review of the TRA area in one visited plant resulted in 3 findings from which there are 2 recommendations, one suggestion and no good practice.
The distribution of the findings between the different topics of the TRA review is presented below:

Title		Rec.	Sug.	GP	Total
12.1	Management of the transitional period	0	1	0	1
12.2	Human resources management	0	0	0	0
12.3	Conduct of operations	0	0	0	0
12.4	Work management and housekeeping	0	0	0	0
12.5	Technical support activities for the transitional period	0	0	0	0
12.6	Special safety assessments and risk analyses required	0	0	0	0
12.7	Utilisation of operational experience	0	0	0	0
12.8	Radiation protection requirements for the transition period	2	0	0	2
12.9	Emergency planning and preparedness	0	0	0	0
12.10	Core management and fuel handling	0	0	0	0
12.11	Chemistry	0	0	0	0
Total		2	1	0	3



2.12.1. Management of the transitional period

• Findings: no recommendation, one suggestion, no good practice

There is one issue regarding the adequacy and security of financial provisions for decommissioning of the plant and final disposal of radioactive waste.

2.12.2. Human resources management

• No findings

2.12.3. Conduct of operations

• No findings

2.12.4. Work management and housekeeping

• No findings

2.12.5. Technical support activities for the transitional period

• No findings

2.12.6. Special safety assessments and risk analyses required

• No findings

2.12.7. Utilisation of operational experience

• No findings

2.12.8. Radiation protection requirements for the transition period

• Findings: 2 recommendations, no suggestion, no good practice

• One issue is that storage capacity and conditions of Intermediate Level Waste was inadequate. The other is regarding long term strategy for waste management at the plant site.

2.12.9. Emergency planning and preparedness

• No findings

2.12.10. Core management and fuel handling

• No findings

2.12.11. Chemistry

• No findings

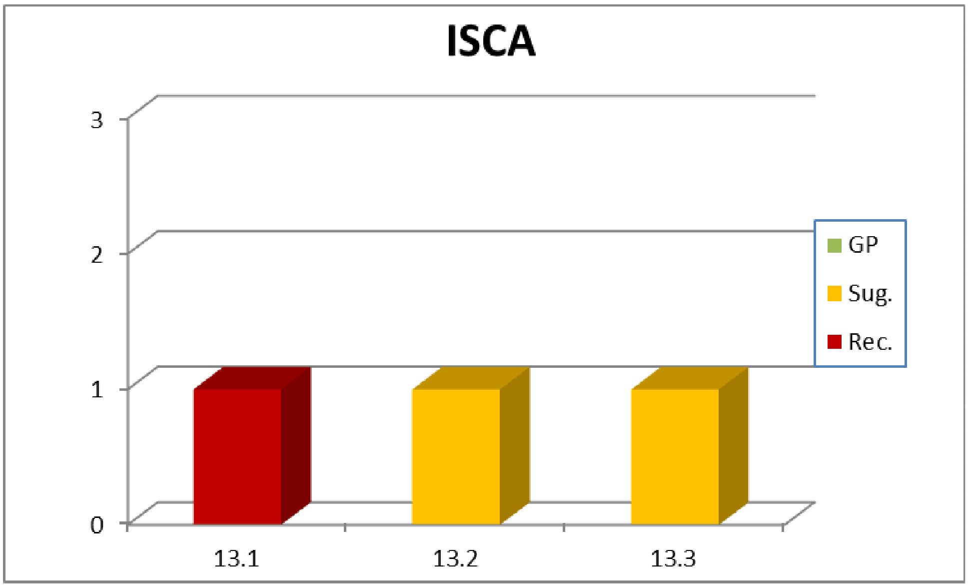
2.13. Independent Safety culture Assessment

2.13.0. Summary of findings

The review of the ISCA area in 2 visited plant resulted in 6 findings.
The distribution of the findings between the different topics of the ISCA review is presented below.

	Title	Rec.	Sug.	GP	Total
13.1	Work and management practices	1	0	0	1
13.2	Safety image, relationships and ability to challenge and question	0	1	0	1
13.3	Leadership, human performance and organizational aspects	0	1	0	1
	Total	1	2	0	3

*In one of 2 missions where ISCA was reviewed, 3 issues were identified. However, those 3 issues are not included in the table above, because the terms ‘recommendation’ and ‘suggestion’ are not used for those issues in the review report. Those 3 issues are all categorised in 2.13.3 Leadership, human performance and organizational aspects.



2.13.1. Work and management practices

• Findings: one recommendation, no suggestion, no good practice

• The issue is that some aspect of the formal organizational management were missing and the utility and plant did not clearly understand how omitted aspects could compromise nuclear safety.

2.13.2. Safety image, relationships and ability to challenge and question

• Findings: no recommendation, one suggestion, no good practice

• There is one issue regarding insufficient critical thinking, willingness to challenge, and critical questioning

2.13.3. Leadership, human performance and organizational aspects

• Findings: no recommendation, one suggestion, no good practice and 3 other issues

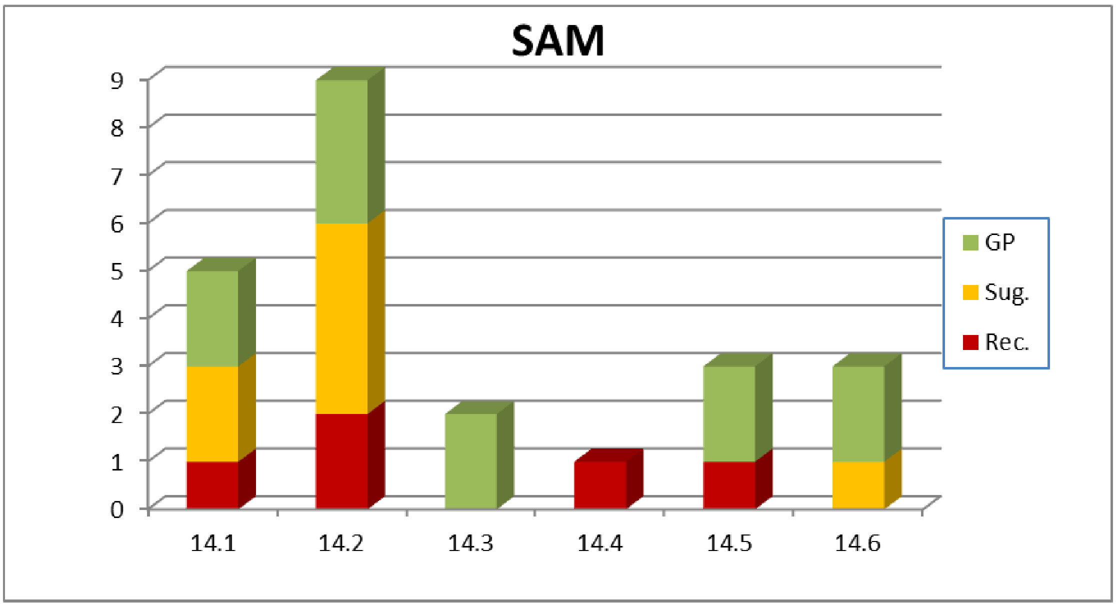
• 4 issues identified are presented below. However, no trends were found.
- There is no clearly defined programme regarding required leadership expectations and competencies as well as selection criteria for leadership positions.
- Some aspects of leadership behaviour do not always address the human aspect that is important for a strong safety culture.
- Some personnel do not understand the importance and value of problem identification and resolution.
- There is a lack of awareness of some aspects of the individual, technology, and the organization and the impact that they can have on safety culture.

2.14. Severe accident management

2.14.0. Summary of findings

The review of the SAM area in the 8 visited plants resulted in 23 findings from which there are 5 recommendations, 7 suggestions and 11 good practices.
The distribution of the findings between the different topics of the SAM review is presented below:

Title	Rec.	Sug.	GP	Total
Development of severe accident management strategies	1	2	2	5
Development of procedures and guidelines	2	4	3	9
Responsibility and plant emergency arrangement	0	0	2	2
Verification and validation of procedures and guidelines	1	0	0	1
Training needs and training performance	1	0	2	3
Accident management programme updating and revisions	0	1	2	3
Total	5	7	11	23



2.14.1. Development of severe accident management strategies

• Findings: one recommendation, 2 suggestions, 2 good practices

• No trends

• There are 3 issues related to the absence of severe accident management programme (SAMP), the lack of detailed information (e.g. priority of measures, assessment of negative impacts) and insufficient covering of the whole spectrum of challenges to the containment.

• 2 good practices are identified. One is related to the development of severe accident management guideline (SAMG) for shut-down conditions and accidents involving the spent fuel pool, and this is counted in a trend found in 2.14.2; the other is related to in house severe accident analysis, PSA and SAMG development.

2.14.2. Development of procedures and guidelines

• Findings: 2 recommendations, 4 suggestions, 3 good practices

• Trend: In some plants, SAMP does not cover all accident situations at site. (6/19 (including one issue identified in 2.14.6, on issue identified in 2.3.3 and 2 issues identified in 2.3.7))

Examples show that :
– The SAMPs do not consider accidents in open reactor conditions or accidents involving spent fuel pools.
– The SAMP does not address insights from level 2 PSA, such as manual containment isolation in the event of station blackout prior to core damage..
– The SAMP does not comprehensively address possible consequences of prolonged station blackout including complete loss of all AC and DC power sources.
– Level 2 PSA is not developed or updated.
– The final safety analysis report does not contain analysis of severe accidents.

The plants should extend the SAMP coverage to address the full spectrum of challenges.

• Trend: In a few plants, SAMG is extended to scope accidents during shutdown conditions and accidents involving the spent fuel pool. (2/19, Good practice (including one good practice identified in 2.14.1))

These good practices are completely contradictory to the issues trended above. This contradiction might be due to lack of experience of reviewing severe accident management area in OSART missions. In principle what is required by IAEA Safety Standards should not be identified as good practice.

• Trend: In a few plants, available plant specific inputs for mitigative accident management actions in SAMGs are not sufficient for validation of SAMGs. (2/19)

Examples show:
– Plant specific analyses are not available e.g. analysis to determine the amount of time available for implementation of mitigation actions, analysis of containment behaviour, source terms associated with certain SAMGs actions, radiation levels in working places etc.

The plants should perform specific analyses of representative severe accidents for the validation of SAMGs.

• The other issues are related to procedure for using containment venting system and assessment of the resistance of equipment to withstand hazards.

• The other good practices are related to SA analysis, PSA and SAMG development within the company, monitoring of external industrial activity and special guidance for flood protection.

2.14.3. Responsibility and plant emergency arrangement

• Findings: no recommendation, no suggestion, 2 good practices

• There are 2 good practices regarding the SAMP supported by a wide range of expertise and analytical tools and the expert system for source term evaluation.

2.14.4. Verification and validation of procedures and guidelines

• Findings: one recommendation, no suggestion, no good practice

• Trend: In a few plants, SAMP is not yet fully implemented and the execution plan for future steps is insufficient. (2/19 (including one issue identified in 2.14.5))

Examples show:
– Although formally the SAMGs which reflect existing plant configuration are available, validation and training are yet to be implemented.
– Procedures for validation and verification process of SAMG is established but not systematically followed.
– Internal manpower devoted to the development and implementation of SAMG is limited.

2.14.5. Training needs and training performance

• Findings: one recommendation, no suggestion, 2 good practices

• No trends

• The issue identified is related to insufficient implementation of SAMP, and counted in 2.14.4.

• There are 2 good practices related to on-line data transmission from the full-scope simulator to the technical support centre and the manual forming technical bases for decision making process performing by the technical support centre. Although both of them support decision making of technical support centre, no clear trend is found.

2.14.6. Accident management programme updating and revisions

• Findings: no recommendation, one suggestion, 2 good practices

• No trends

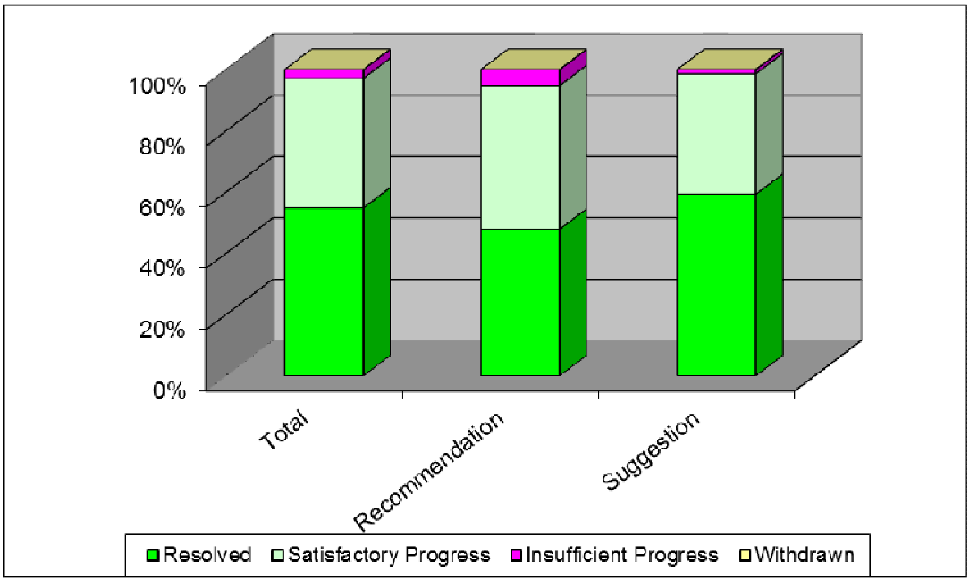
• The issue identified is related to the SAMP coverage of all accident conditions, and counted in 2.14.2.

• There are 2 good practices related to the external event review team and the backup of cooling functions.

2.15. OSART at the follow-up visit

OSART follow-up visits are conducted as an integral part of the OSART process, approximately 18 months to two years after the main OSART mission. From 2010 to 2012, 15 follow-up visits listed below were conducted.

Plant	Country	Year
Balakovo 4	Russia	2010
Arkansas	USA	2010
Cruas	France	2010
Rovno 3/4	Ukraine	2010
Mihama 3	Japan	2010
Oskarshamn	Sweden	2010
Fessenheim	France	2011
Vandellos 2	Spain	2011
South Ukraine	Ukraine	2011
Ling Ao 3/4	China	2011
Ringhals 3/4	Sweden	2011
Doel	Belgium	2012
St. Alban	France	2012
Bohunice 3/4	Slovak	2012
Angra 2	Brazil	2012



As shown in the figure above, during this period, 97.2% of the issues (recommendations and suggestions) were either totally resolved or satisfactory progress was made. Only 2.8% of the issues were concluded as having “insufficient progress”. Among 246 issues, no issues were withdrawn.

In comparison between recommendations and suggestions, the rate of issues resolved or in satisfactory progress is slightly lower in recommendations. It might be reasonable because recommendations are generally more essential and thus it takes longer time to address them.

In any case, these results of the follow-up visits demonstrated the effectiveness of the OSART service and the commitment of the plants to implement improvements identified by OSART teams.

3. ASSESSMENT OF OVERALL OSART MISSION RESULTS

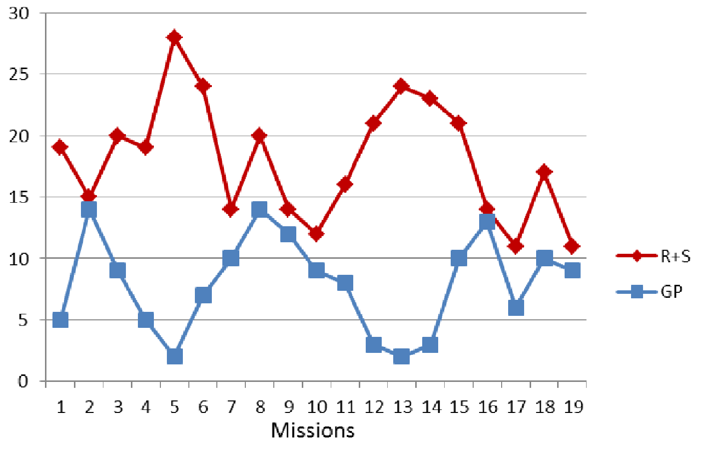
3.1. Feature of findings

3.1.1 Findings in each review area

	MOA	TQ	OPS	MA	TS	OEF	RP	CH	EPP	SAM
Issues	**39**	**15**	**56**	**41**	**36**	**39**	**36**	**34**	**21**	**12**
(Rec.)	20	6	30	16	14	16	17	14	14	5
(Sug.)	19	9	26	25	22	23	19	20	7	7
Good Practices	**13**	**18**	**16**	**20**	**11**	**14**	**20**	**14**	**13**	**11**
Applied Missions	19	16	19	19	19	19	19	19	15	8

The table above shows the numbers of findings in each standard review area. This table indicates two characteristic features. One is that the number of issues per mission is the lowest in TQ area. The reason might be that plants' practices are more in-line with requirements of safety standards in TQ area than in other areas. The other feature is that the rate of recommendations against suggestions is the highest in EPP area. The reason might be that EPP area has the dedicated safety requirement GS-R-2 which describes details of emergency planning and response.

3.1.2 Correlation of findings



Correlation of findings (R+S ver. GP)

Above figure summarizes the numbers of findings in each OSART mission (red for the sum of the recommendations and suggestions and blue for the good practices). These figure obviously shows that the number of issues and that of good practices are negatively correlated, i.e. wherever the number of issues is high, the number of good practices is low and vice versa. It might be a proof that whole aspects of the plant are appropriately grasped in each mission based on the IAEA safety standards.

3.2. References used in the reports

3.2.1 Frequency of references to main safety requirements and safety guides

The table below shows the numbers of times referenced of main safety requirements and safety guides in 19 missions.

Safety requirements or guides	The number of times referenced
SSR-2/2; Safety of Nuclear Power Plants: Operation and Commissioning (or NS-R-2)	152
NS-G-2.1; Fire Safety in the Operation of Nuclear Power Plants	19
NS-G-2.2; Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants	11
NS-G-2.3; Modifications to Nuclear Power Plants	14
NS-G-2.4; The Operating Organization for Nuclear Power Plants	61
NS-G-2.5; Core Management and Fuel Handling for Nuclear Power Plants	8
NS-G-2.6; Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants	59
NS-G-2.7; Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants	37
NS-G-2.8; Recruitment, Qualification and Training of Personnel for Nuclear Power Plants	21
NS-G-2.9; Commissioning for Nuclear Power Plants	7
NS-G-2.10; Periodic Safety Review of Nuclear Power Plants	10
NS-G-2.11; A System for the Feedback of Experience from Events in Nuclear Installations	38
NS-G-2.12; Ageing Management for Nuclear Power Plants	7
NS-G-2.13; Evaluation of Seismic Safety for Existing Nuclear Installations	1
NS-G-2.14; Conduct of Operations at Nuclear Power Plants	53
NS-G-2.15; Severe Accident Management Programmes for Nuclear Power Plants	16
SSG-13; Chemistry Programme for Water Cooled Nuclear Power Plants	33
GS-R-2; Preparedness and Response for a Nuclear or Radiological Emergency	21
GS-G-2.1; Arrangement for Preparedness for a Nuclear or Radiological Emergency	11
GS-R-3; The Management System for Facilities and Activities	33
GS-G-3.1 Application of the Management System for Facilities and Activities	33
GS-G-3.5 The Management System for Nuclear Installations	30

3.2.2 NS-R-2 and SSR-2/2 as references

NS-R-2; Safety of Nuclear Power Plants: Operation had been the requirement which comprehensively covers activities related to the operational safety of NPPs before superseded by SSR-2/2; Safety of Nuclear Power Plants: Operation and Commissioning published in 2011. These two requirements are the most common requirement used in OSART mission reports. In 9 missions out of 19 missions, NS-R-2 is applied, and in other 10 missions, SSR-2/2 is applied. The numbers of usages of these two requirements in 19 missions are shown in the table below.

	NS-R-2	SSR-2/2
(a)The number of applicable missions	9	10
(b)The number of issues	173	170
(c)The number of times referenced	51	101
(c)/(b)	0.29	0.59

Apparently SSR-2/2 is much more frequently referenced than NS-R-2. This fact can indicate that SSR-2/2 is more detailed and specific thus easier to be referenced. However, at the same time, the attention should be paid on the fact that SSR-2/2 is not used in about 40% of issues, which might indicate the lack of coverage of SSR-2/2. SSR-2/2 is much more suitable for the reference of OSART missions than NS-R-2. However, existing SSR-2/2 should be considered to be insufficient for the new methodology of OSART where requirements are used as criteria.

3.2.3 Frequency of references to each requirement in SSR-2/2

The table below shows the numbers of times referenced of each requirement in SSR-2/2 in last ten missions. The most characteristic feature is that R 24 Feedback of operating experience and R 19 Accident management is referenced by far the most times comparing to the numbers of issues. The reason might be analysed that these requirements are the only possibility to be referenced in OE or SAM review area. Although the same thing can be said about R 18 Emergency preparedness and R 20 Radiation protection, the numbers of times referenced of these requirements are relatively low. The reason is that EPP and RP review area has their own specific requirements other than SSR-2/2 i.e. GS-R-2; Preparedness and response for a nuclear or radiological emergency and GSR Part3; Radiation Protection and Safety of Radiation Sources. In fact, GS-R-2 and GSR Parts3 are referenced 10 times and 8 times respectively in these two review areas.

Requirements in SSR-2/2	Number of times referenced
R 1: Responsibilities of the operating organization	7
R 2: Management system	0
R 3: Structure and functions of the operating organization	0
R 4: Staffing of the operating organization	0
R 5: Safety policy	1
R 6: Operational limits and conditions	0
R 7: Qualification and training of personnel	3
R 8: Performance of safety related activities	2
R 9: Monitoring and review of safety performance	3
R 10: Control of plant configuration	0
R 11: Management of modifications	5
R 12: Periodic safety review	0
R 13: Equipment qualification	3
R 14: Ageing management	2
R 15: Records and reports	1
R 16: Programme for long term operation	0
R 17: Consideration of objectives of nuclear security in safety programmes	0
R 18: Emergency preparedness	**6**
R 19: Accident management programme	**10**
R 20: Radiation protection	**3**
R 21: Management of radioactive waste	1
R 22: Fire safety	6
R 23: Non-radiation-related safety	3
R 24: Feedback of operating experience	**22**
R 25: Commissioning programme	2

R 26: Operating procedures	8
R 27: Operation control rooms and control equipment	3
R 28: Material conditions and housekeeping	9
R 29: Chemistry programme	6
R 30: Core management and fuel handling	1
R 31: Maintenance, testing, surveillance and inspection programmes	11
R 32: Outage management	0
R 33: Preparation for decommissioning	0

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