



ISLAMIC REPUBLIC OF IRAN  
IRAN NUCLEAR REGULATORY AUTHORITY  
NATIONAL NUCLEAR SAFETY DEPARTMENT

*Report on Review and Assessment of  
“Self-Assessment Stress Test Report for Iranian  
NPP”*

**Doc. No. : NS.....**

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## **1. INTRODUCTION**

SAST report prepared for BNPP-1 is developed in full compliance with INRA and ENSREG specifications, follows specification structure and has adequate level of detail to judge on its conclusions on robustness of the plant to withstand impacts of earthquakes, floods, external meteorological effects and natural hazards, as well as plant capacity to withstand loss of power and ultimate heat-sink and cope with severe accidents. Report provides full level of detail on cliff-edge effects and proposes numerous measures to improve quality of safety analyses of relevance and increase robustness of the plant.

It should be highlighted that BNPP-1 has certain design features contributing to higher safety level of the plant if compared with standard WWER 1000 design, including seismic design of the plant, double containment with annulus ventilation, four trains architecture of safety systems, availability of second stage hydro-accumulators, passive autocatalytic re-combiners and hydrogen monitoring system, post-accident monitoring system. To cope with station blackout BNPP-1 could also use five air cooled 4.2 MW 10 kV DGs and three air cooled 2.1 MW 10 kV DGs located in ZK.9 building outside BNPP 1. All these feature already have positive impact on capacity of the plant withstand external impacts and cope with severe accidents.

Lessons learned from EU stress tests were extensively used by the Contractor and significantly helped to develop very good quality SAST report, as well as define numerous safety upgrading recommendations. Stress test exercise resulted in development more than forty recommendations including seven aimed at increasing robustness of the plant against external hazards, six on development and implementation of advanced procedures, five on improvement of human reliability, thirteen on improved use of permanently installed hardware, four on introduction of alternative mobile power and water supply means, five on improved emergency management and seven containing general recommendations on further studies and improvement of the plant safety documentation. All these measures are clearly defined, aimed at increasing plant safety, presented in a structured way and focused on addressing all cliff-edge effects defined by SAST. Some recommendations were originated due to the fact that certain equipment was purchased prior conducting the stress test.

Based on SAST report it is absolutely visible that BNPP-1 is ready and willing, in a co-operative manner, continue implementation of defined by SAST recommendations with ultimate goal to improve safety and robustness of the plant.

## ABBREVIATION

AC	Alternating Current
ANF	Adverse Natural Factors
AM	Accident Management
BDBA	Beyond Design Basis Area
BNPP-1	Bushehr Nuclear Power Plant unit 1
CDFM	Conservative Deterministic Failure Margin
DBE	Design Basis Earthquake
DBF	Design Basis Flood
DC	Direct Current
DG	Diesel Generator
FSAR	Final Safety Analysis Report
GEM	Global Earthquake Model
GMPE	Ground Motion Prediction Equations
ENSREG	European Nuclear Safety Regulators Group
EOP	Emergency Operating Procedures
EU	European Union
I&C	Instrumentation & Control
IAEA	International Atomic Energy Agency
INRA	Iran Nuclear Regulatory Authority
HCLPF	High Confidence of Low Probability of Failure
LOCA	Loss Of Coolant Accident
LOOP	Loss Of Off-site Power
MCE	Maximum Credible Event
MCR	Main Control Room
MDG	Mobile Diesel Generator
MSL	Mean Sea Level
NPP	Nuclear Power Plant
NSSS	Nuclear Steam Supply System
PGA	Peak Ground Acceleration
PMP	Probable Maximum Precipitations
PSA	Probabilistic Safety Assessment
PSR	Periodic Safety Review
PSAR	Preliminary Safety Analysis Report
PSHA	Probabilistic Seismic Hazard Analysis
PWR	Pressurized Water Reactor
SAR	Safety Analysis Report
SAST	Self-Assessment Stress Test
SAMG	Severe Accident Management Guidelines
SBO	Station Blackout
SFP	Spent Fuel Pool
SG	Steam Generator
SL	Seismic Level
SSC	Structure, System and Component
SSE	Safe Shutdown Earthquake

ST	Stress Tests
UHSR	Uniform Hazard Response Spectra
UHS	Ultimate Heat Sink
WWER reactor)	Russian language acronym for PWR (water cooled water moderated power
WENRA	Western European Nuclear Regulator's Association

## **2. COMMENTS ON “SELF-ASSESSMENT STRESS TEST REPORT FOR IRANIAN NPP”**

### **2.1 General Comments on Chapter 1- General data about the site and nuclear power plant**

1. Chapter provided brief description of site and its vicinity, basic information about the reactor technology, information on reactivity control, redundancy and diversity of reactivity control systems, their operational and functional capacities, etc.
2. Chapter provides sufficient level of information on heat transfer from reactor/ spent nuclear fuel pool/containment to the ultimate heat sink (primary or secondary) in different reactor operation modes and gives an understanding of available means/strategies to ensure heat transfer from the containment to the ultimate heat sink in all circumstances, also including the situations after a severe damage of the nuclear fuel.
3. Chapter provides sufficient level of information on AC power supply (off-site, on-site), back-up power supply sources, diverse back-up sources, other power sources that are planned and/ or kept in preparedness, as well as batteries dedicated for DC power supply and intention to use new mobile DGs to re-charge the batteries in emergencies.
4. Chapter provides details on probabilistic safety assessments (PSA) of the Bushehr-1 NPP that have been performed to provide important safety insights in addition to those provided by deterministic analysis. Chapter also states that there are intentions to use updated PSA as ‘living PSA’ to reflect the current design and operation of the plant and current analysis of its transients.

### **2.2 General Comments on Chapter 2 - Earthquakes**

1. The chapter provide information Design basis earthquakes, evaluation of safety margins, as well as on measures envisaged increasing robustness of the NPP against earthquakes.
2. Report states that specific information on how the safety margins have been evaluated is not available, however it is task of the Authors to provide this information, so this have to be asked from BNPP-1 and addressed. Report also states that safety margin was, in the case of BNPP-1, were defined using the probability of exceedance  $1 \times 10^{-4}$  for 84th percentile value (or median +  $\sigma$ ) and that this approach has been used in the past, but it is advisable to make a comparison with the value of the safety margin determined by the current up-to-date approach. However such a recommendation is not listed in the list of recommendations in section 7.3.1.
3. According to IAEA standard that applied at the time of the seismic hazard evaluation two levels of ground motion hazard were evaluated, here named SSE (i.e. SL-2) and DBE (SL-1). However, in the report there is no information for the mean PGA estimations for the BNPP site SL-1.

4. It is recommended that the PSHA logic tree should be more fully developed to fully account for the epistemic uncertainties that exist in the characterization of the seismogenic structures and zones of diffuse seismicity in the regional and local areas around the NPP site.
5. Shahvar et al. (2013) conduct a regional study, where 3 regression methods (SR, ISR and OR) are used and an appropriate model is chosen for each magnitude conversions. It is recommended to compare some representative magnitudes with evaluated magnitudes by well recognized and known other publications, to show coherency (for instance with Scordilis (2006), in where the data set used contains 20,407 earthquakes, which occurred all over the world during the time period 1976–2003, for which moment magnitudes are available).
6. It is recommended to show completeness periods for whole catalogue.
7. There is no description of location error in the report. It is recommended to use information of location error.
8. Developed seismic source models are differing by their radius of the region under study. It is recommended to develop regional seismotectonic models with a radius at least 300 km around the site in order to consider the potential influence of all the seismic sources on the seismic motion at the site. For model SM1-BNPP1 (figure 1.4) it is not clear whether at the site any seismicity is assumed. In all 4 seismic source models (even with  $R=150\text{km}$ ) there are areas without assigned seismic parameters, i.e. no seismic sources are considered, which should be taken into consideration.
9. One more recommendation concerns the Persian Gulf, which did not consider in the source models. For example, according to Johnston (1989) the region as stable Africa consists of 4 separate areas (Africa, Saudi Arabia etc.). The Persian Gulf is within the stable crustal zone, in this regard, it could be appropriate to modify Seismotectonic Models by including the mentioned area and assign appropriate seismicity parameters and  $M_{\text{max}}$  with their uncertainties according to Johnston (1989).
10. Determination of the maximum magnitude presented without introducing uncertainties. The maximum magnitude considered in a zone should be at least equal to the maximum observed magnitude increased by its uncertainty. For definition of  $M_{\text{max}}$  it is recommended to use combination of geological and/or paleoseismological data with tectonic environment.
11. Instrumental part of the catalogue allows to determine the depth of earthquake with more or less acceptable accuracy. It is therefore recommended to evaluate the focal depth distribution to justify the basis of the given depths.
12. The GR b-values in the region of interest are informative. The assigned regional value to the b parameter should be strongly justified. It is also recommended to take into consideration the uncertainty of the seismicity parameters in the logical way.
13. The selection of GMPEs needs to be strongly based on the comparison with the observed strong motion records, and preferably, regional GMPEs need to be used. For ranking GMPEs, suitable for the seismotectonic context of the region, it is

recommended to use also the selection criteria from recent research projects on seismic hazard studies, like SHARE at European scale, or GEM at worldwide scale, procedures for selection of GMPEs.

14. Disaggregation of the seismic hazard issued from the logic tree should be performed in order to evaluate the respective contribution of seismic sources to the hazard at the site.
15. Disaggregation by magnitude and distance, and the disaggregation by seismic sources should be performed.
16. It is recommended to implement Monte Carlo simulations for each main branch to generate secondary branches that allow propagating the uncertainties. The choice of the 300 km radius seems appropriate for the regional area, however the background for this choice should be well explained.
17. Report, in section 5.1.2.1, provides information on structures, systems and components that are required for providing of safety functions for the SFP. However it would be useful to introduce additional table listing SSCs that are required for SFP cooling in section 2.1.2.
18. Report provides description of the SFP SSCs, but information on seismic resistance of the system components is lacking. It is recommended to include in SAST table similar to table 2-8, but for SFP cooling equipment.
19. Report lists 3 items already purchased by BNPP-1 – mobile diesel generators (2MW 10 kV and 0.2 MW 0.4 kV) and mobile pump with rated capacity Q150@h900 for SG make-up. Other mobile equipment is under consideration. Connection points of already available equipment are not defined.
20. The report does not provide list of SSCs that can cause a consequential damage to the SSCs required to remain operable following a seismic event, but refers to Russian document “Detailed seismic walk-down of BNPP 1”. Neither list of equipment nor reference in the list of references are included in SAST.
21. The report lists 18 systems’ maintenance programs for systems that are relevant for safe shutdown following a seismic event. YP system is missing among those. 16.BU.1 ZF.RA.AB.WI.ATEX.001 listed twice for different systems, Programs 14 and 15 have same title. Deficiencies need to be addressed.
22. Report did not provide information on any known deviation from current licensing basis and their consequences, but rather refer to “Report on safety analyses of Bushehr NPP at extreme external impacts” from May of 2012.
23. Report did not provide information on any additional post-Fukushima compliance checks except SAST review.
24. BNPP-1 off-site electric supply could be arranged using five 4.2 MW 10 kV and three 2.1 MW 10 kV DGs located outside BNPP in building ZK.9. Damage to the building or fire caused by seismic event could prevent using them as alternate power supply source. ZK.9 building and DGs are of Seismic Category III so might not withstand seismic event, so could not be credited in full.



25. Report states that maintenance programmes for connecting and maintenance of the mobile equipment are under preparation and that operating and training procedures for mobile equipment are not yet available.
26. According to section 2.2.1.4.2 three Seismic Category I plant components could not withstand  $0.2 \text{ g} < \text{PGA} < 0.40 \text{ g}$  earthquake- i.e. GY10,20,30,40B002; TH50-70 flanged connection bolts and TW10,20,30B003,004. Report did not mention any measures aimed at elimination of these deficiencies among recommendations for safety enhancements.
27. Evaluation of plant level seismic margin ranges, depending on structure/facility, from 0.1g to more than 0.6g PGA. Seismic margin evaluation indicates that core damage would be likely are at HCLPF range from 0.55 g to 0.60 g. However, report does not include evaluation of seismic margins for spent fuel pool.
28. While section 2.1.2.1 identifies SSCs required for achieving safe shutdown state and are most endangered during an earthquake includes classification of systems, but not lists SSCs required for safe shutdown.
29. Report identifies success paths with focus of Nuclear Steam Supply System (reactor, primary loop, steam lines), loss of offsite power and containment integrity, however report does not include similar discussion for SFP.
30. Report does not provide evidence on possible impact of nearby SSC with lower seismic category and vulnerability on the first category SSCs.
31. Report provides evaluation of containment behaviour for three ranges of earthquakes up to PGA exciding 0.60 g, however reference to specific report or analysis is missing.
32. While report lists (in 2.2.4.1.1) seven measure for hardware modification, two for procedures and seismic hazard reassessment, report did not provide information on what was the basis for these recommendations and did not refer to any analysis or study that defined those.

## **2.3 General Comments on Chapter 3 - Flooding**

1. The chapter provide information Design basis flood, evaluation of safety margins, as well as on measures envisaged increasing robustness of the NPP against flooding. After the screen-out process of the potential for flooding sources for flooding due to extreme precipitation and flood due to high sea water level were determined as the potential threats at Bushehr NPP site.
2. The probable maximum flood taken as design basis is 5.2 m above mean sea level defined as a combination of maximum run-up elevation due to extreme precipitation and probable maximum tsunami.
3. The report does not contain site hazard curves for floods (functional dependence between the severity of hazard and frequency of occurrence) and it is also believed that design basis flood precipitations represent median values.
4. Hydrological study was developed in 1997 and the input data used in the study are more than 20 years old, new studies have been published regarding the tsunami

hazard in Persian Gulf. They proved that the tsunami generated by landslides could be more serious than the tsunami generated by earthquake itself, but report does not include this specific study in recommendations. The hydrological studies are based on outdated meteorological and hydrological data and non-actual methodology. The studies should be updated to cover current international practice

5. Report did not provide description of used for evaluation methodology/ technics, models, assumptions, conditions or parameters, criteria and justifications.
6. The SAST report mentions a use of historical data to develop the site characteristics; however neither historical flood events nor measured extreme precipitations are listed in SAST.
7. The SAST report concludes that the uncertainty/sensitivity analyses in identification of site characteristics and consequent determination of DBF are not performed in full scope. The impact of inputs and assumptions on the calculated results is not provided. It is not known what quantile (median, mean, or any other) represents the site characteristics used for determination of DBF (to use of confidence level higher than the median of the hazard curve is expected according to WENRA reference levels T 2.2). It is believed that design basis flood precipitations for Bushehr site represent median values.
8. Report did not describe how the site characteristics were transferred into DFB characteristics for all types of considered floods. Safety margin incorporated into the DBF determination for extreme precipitations is not evaluated.
9. Site characteristics for flooding caused by extreme precipitations use site specific data from time period 1951-1995 (-2010). Site characteristics for flooding caused by sea use regional data from Persian Gulf. Deterministically developed characteristics for high sea water level take into account tsunami, tide, storm, slope slides, etc., but not all physical phenomena that have a potential to increase the height of flood are adequately covered in the light of new knowledge and recent practices. Site evaluation used the methodology and knowledge that was known at the time of the evaluation, which does not fully correspond to current knowledge and practices. The review identified missing uncertainty and sensitivity analyses, physical phenomena that have a potential to increase the height of flood are not fully covered and site flooding model is too simple. The model does not take into account variability in rain intensity over the day or morphology of the site. Changes due to climatic evolution should be taken into account and possible consequences in relation to meteorological extremes should be considered for the planned operating lifetime of the plant.
10. There is a recommendation in SAST report to update the site characteristics in the next Periodic Safety Review (PSR) to be in line with best available knowledge and state-of-the-art methodology. Impact of update of site characteristics on DFB is not discussed in the SAST report. It could result in improvements of accuracy in site characteristics and justifications.

11. Relevant surveillance programmes associated with design and construction provision included in the NPP design to protect the site against flooding are not mentioned in the report, as so far are not developed. Currently there are also no procedures describing operating provisions dedicated specifically to dealing with flood events.
12. Report does not contain post-Fukushima measures listed which are directly connected with the flood events.
13. Report states that 1ZE building has entrances below postulated water level and has doors with undefined permissible leakage. These doors are not watertight and may allow for
14. water ingress that might result in flooding of the underground part of the building together with the first floor up to 356 mm above the ground. While report states that “basement areas of the building could be gradually flooded, but loss of electrical and I&C function is not expected for flooded cables due to their construction properties” it does not indicate any recommendations on elimination of this deficiency for 1ZE building (e.g. installation of level alarms, water screens, drainage pumps etc).

## **2.4 General Comments on Chapter 4 - Extreme meteorological events and other natural hazards relevant for the site**

The chapter provide information on meteorological events and other natural hazards relevant for the site, evaluation of safety margins, as well as on measures envisaged increasing robustness of the NPP against meteorological events and other natural hazards relevant for the site.

Temperatures, sea water temperatures, wind, tornadoes and waterspouts, thunderstorm and lightning, dust storm, hail, freezing rain and snowpack were selected for analysis of their potential hazard in the Bushehr NPP site. Based on long term observations or on long term measured data the meteorological events were identified which potential hazard cannot be screened out. For detailed analysis and for determination of values for design parameters of structures, systems and components following meteorological events were selected:

- - extreme outside air temperature,
- - extreme sea water temperature,
- - extreme winds,
- - tornado,
- - dust storms.

Preliminary screening of potential combination of extreme meteorological events concluded that most of the hazards can be assumed as independent of each other (as the probability of these combinations occurring simultaneously is very low) and can be screened out from the detail analysis.

The report provides basic information about identification, screening and analysis of screened out extreme meteorological events relevant for the site. Detailed information is provided in the referenced Final Safety Analysis Report (FSAR) and meteorological studies. The list of credible extreme meteorological events for the site includes extreme air and sea water

temperatures (minimum/maximum), wind, tornadoes and water spouts, thunderstorm and lightning, dust storm, hail, and freezing rain.

The report concludes that the list of meteorological events relevant for the site is not adequately justified. The selected meteorological events correspond to the site characteristics; however, the screening process of the hazards and their combinations is not properly described and documented in the meteorological studies and FSAR. Transfer of site characteristics into DB characteristics is described not for all types of considered events. Safety margins incorporated into the DB determination are not evaluated.

The self-assessment concluded that there is no independent monitoring and alerting systems for extreme meteorological phenomena at BNPP; warnings and meteorological conditions are sent to the BNPP through the meteorological centres. Report recommended establishing the appropriate monitoring and alert processes and operational measures to support protection against extreme meteorological phenomena.

1. IAEA Safety Standards was adopted for the design, using the hazard level consistent with 10 000 years return period (frequency equivalent to  $10^{-4}$  per year), however, the selection of the most appropriate statistical distribution for the data set is not adequately documented. Several different distribution functions (i.e., Normal, two parameters Log-Normal, two parameters Gamma, Type-3 Pearson, Type-3 Log-Pearson, and Gumbel) were used in the study and the most conservative value was chosen as design basis value. Hazard curves are not provided. Transfer of site characteristics into DB characteristics is described not for all types of considered events.
2. It is not described how the site characteristics were transferred into DF characteristics for all types of considered events. Safety margin incorporated into the DB determination is not evaluated.
3. Site characteristics for extreme meteorological events use site specific data from time period 1951-1995 (-2010). Site evaluation uses the methodology and knowledge that was known at the time of the evaluation, which does not fully correspond to current knowledge and practices used. The review identified missing uncertainty and sensitivity analyses. Changes due to climatic evolution should be taken into account and possible consequences in relation to meteorological extremes should be considered for the planned operating lifetime of the plant.
4. The report stated that is not clear, whether the impact of tornadoes (pressure drop) on heat, ventilation and air conditioning system (HVAC) was adequately analysed.
5. Design basis for high temperature with return period 10 000 years is 59°C. The NPP cooling systems use sea water. If circulating, the sea water temperature cannot exceed the design limits but could reduce the heat sink efficiency. High air temperature cannot lead to the loss of the safety functions. Most vulnerable items in relation of high air temperatures are compartments with electrical and I&C systems. The report recommends carrying out analyses/re-evaluate the HVAC system for confirmation to

ensure design specified indoor environmental conditions during extreme outdoor temperature.

6. Significant increase of the sea water temperature can affect the effectiveness of the cooling. Detailed analysis should be conducted, including the overall plant (time of cool down, value of heat dissipated, etc.) response to the event.
7. Extreme hot air and seawater temperature, extreme precipitations or dust storm represent meteorological phenomena that develop relatively slowly and can be reasonably predicted by weather forecast. For such phenomena, the preventive measures can be prepared some time in advance. It is recommended to establish the appropriate monitoring and alert processes and operational measures to support protection against extreme meteorological phenomena.
8. Timing between extreme weather conditions warning and extreme weather impact of the NPP site itself is not taken into account in analyses in the results.
9. The selected meteorological events in chapter 4 correspond to the site characteristics; however, the screening process of the hazards and their combinations is not properly described and documented in the meteorological studies and FSAR.

## **2.5 General Comments on Chapter 5 - Loss of electrical power and loss of ultimate heat sink**

The chapter provide information on loss of electrical power and loss of ultimate heat sink, evaluation of safety margins, as well as on measures envisaged increasing robustness of the NPP against loss of electrical power and loss of ultimate heat sink.

1. The unit is equipped with 4 trains EDGs designed to cope with LOOP. As one of the possibilities to cope with LOOP the report also mentions work of TG in house-load power supply mode; however this is limited to 50 minutes and has not been tested, so could not be credited until confirmed by tests.
2. Report states that plant has other tanks with diesel fuel located outside of BNPP site (for the auxiliary boiler with  $(2 \times 250 \text{ m}^3)$  of fuel), however those are of Seismic Category III, therefore could not be credited for strong seismic impacts.
3. Impact of extreme wind, hurricane, tornado and extreme rainfall were not studied yet for plant power distribution system components.
4. The report states that plant (common) EDGs with rated power of 3.1 MW is considered as diverse permanently installed back-up power source to cope with LOOP. However DG itself and building where it is installed are qualified as Seismic Category 3 with horizontal acceleration 0.1 g and vertical acceleration 0.07 g respectively. Also impact of extreme floods was not considered in qualification of the common EDG.
5. Two MDGs - 2MW 10kV and 0.2 MW 0.4 kV were purchased by the plant to cope with SBO, however neither connection points no procedures for using them are currently available. Report did not explain logic of MDG selection. It looks like that limited rated

power of MDG – 2 MW will not allow to power all equipment that required for transferring unit into cold shutdown state.

6. Time for connecting MDGs and offsite DGs (five 4.2 MW 10 kV and three 2.1 MW 10 kV) is not known as those connections were never tested, procedures to use those and MDGs connection points are not yet identified. Report states that 4.2 MW 10 kV and three 2.1 MW 10 kV are connected to 10 kV busbars, however were never tested to provide power. None of report figures show such connections. Procedure to use those is not available.
7. Report indicates necessity implementation of the SAMGs and symptom-oriented EOPs for all plant and SFP operating modes that shall consider all internal and external connections. Currently those are not available however Implementation of SAMGs/EOPs is defined as Medium Term measure.
8. The report indicates that battery depletion time is in range of 2 hours, with potential extension to 3 hours in case of loads shedding; however procedure to do this is not available. Report states about intention to use 0.2 MW MDG for recharging batteries in case of SBO, but procedure is not yet developed.
9. Report present information on fire trucks available in the plant's fire brigade. Those could be used for pumping water out of buildings in case of floods, but also for reactor, SG or SFP make-up as last resort measure, however neither connection points nor procedures are available to use those for these purposes.
10. Report does not discuss any measures related to increase availability time of alternate heat sinks for closed primary circuit.
11. BNPP-1 design foresees only one system for SFP cooling, so there are no other dedicated heat removal and SFP make-up systems for SFP severe accident management at BNPP -1. There is no diverse system for flooding/ spraying/ make up the SFP inventory using alternative water supply sources. The most critical for damage from the fuel point of view is case when all SNF is unloaded from the reactor core into SFP (~26-30 hours till fuel uncover) if power supply is not restored, however according to SAST currently there is no specific BNPP-1 analyses for progression of an accident in the SFP into severe accident conditions. Currently there is no specific EOP for shutdown or for SFP operation. Report proposes to conduct analysis for SFP make-up using mobile pump connected to demineralised water or ECCS tank.
12. Report lists provisions aimed at addressing identified cliff-edge effects or increasing plant robustness. Report foresees development of EOP and SAMG covering SFP operation and fuel accidents supported by analyses (medium term), installation of fixed connection points for diverse mobile pumps (medium term), use of existing pumps for SFP make-up (short term), functioning of require instrumentation (short term), use MDG to provide power to existing pumps (medium term), development of strategies for using mobile means (medium term), sufficient amount of water for SG and SFP (short term), assessment of potential recriticality of damaged core and SFP (long term), analysis of severe accidents in SFP (long term).

13. Additional analyses could be carried out to study possibility increasing seismic resistance of these buildings where common diesel and auxiliary boiler fuel tanks are located, as well as study of impact of extreme wind, hurricane, tornado and extreme rainfall on plant power distribution system. It is also necessary to define connection points and develop procedures on use of mobile diesels, off-site located DGs and mobile pumps, as well as periodically test their performance and train BNPP personnel on using all available alternative water and power supply means available on site and in its vicinity.
14. In order to use fire trucks available in the plant's fire brigade for reactor, SG or SFP make-up as last resort measure it is necessary to define connection points, install compliant fittings, as well as develop procedures to use those for these purposes.
15. There is not clear used documents for method of stress test and algorithm for preparing final test results in different fields and systems in Bushehr nuclear power plant.
16. It should be mentioned difference between type nuclear power plants especially Russia reactors and other nuclear power plants in the world for approaching evaluation on the stress test.
17. The equipment's ages should be considered in the assessments stress test for instrumentation and control systems
18. For mobile diesel generators it should be mentioned about safety and trustable connection to emergency powers supply.
19. Page 210, in the last paragraph the word "gas" should be replaced by words "fossil thermal,"
20. Page 212, in second paragraph the words " the steam-dump valves atmosphere" should be replaced by the words "the steam dump valve with discharge to atmosphere" (based on abbreviation of BRU-A). This matter should be considered in all parts of the document.
21. In all parts of report the "PNAE G-5-006-87" should be replaced by the updated document "NP-031-01,"
22. In all parts of report the document "PNAE G-01-011-97 (OPB 88/97)" should be replaced by the latest version "N- 001-15,"
23. There are some editorial errors in the report then it should be revised (for example: page 14, in abbreviation section the word "unservised", page 219 in the 6-th paragraph the word
24. "uncovery", page 247 in the first paragraph the word "non-boated"
25. The most critical for damage from the fuel point of view is case when all SNF is unloaded from the reactor core to SFP (~26-30 hours till fuel uncover) if power supply is not restored, however according to SAST currently there is no specific BNPP-1 analyses for progression of an accident in the SFP into severe accident conditions.

## **2.6 General Comments on Chapter 6 - Severe accident management**

The chapter provide information on severe accident management, evaluation of factors that may impede accident management and respective contingencies, as well as on measures envisaged enhancing accident management capabilities.

### **ACCIDENT MANAGEMENT**

1. The report in comprehensive manner present BNPP-1 accident management arrangements, organisational structure and communication scheme. However, organisational structure and communication scheme figures include number of abbreviations that are not listed in the “ABBREVIATION” table of the document.
2. The report provides information on BNPP- 1 organizational structure, composition of the shift and number of shift operation personnel, covering also number of emergency staff presented in case of accident in MCR and plant management duties to announce Site Area Emergency» or «General Emergency» and defines timing for emergency actions and notifications. However, the report does not provide details who are assigned with duties to support MCR operators during accidents (emergency staff) and what are their functions and responsibilities. While report mentions external emergency support personnel and refers to emergency procedures and plans it does not include details on emergency support arrangements – i.e. composition, number of persons, duties, areas of responsibilities etc.
3. The report provides an overview of measures intended to enable optimal intervention by personnel carried out according to emergency operating procedures and guidelines for beyond design basic accidents for BNPP – 1 that are in place, however both procedures and guidelines are event oriented and SAMGs are so far not available.
4. Report includes full details on use of off-site technical support for accident management as well as lists formal procedures used for coordination of activities; however report refers only to BNPP-1 EP&R procedures, while formal procedures are also required for all local authorities and organisations. It is not clear from the report whether BNPP EP&R plan covers also those organisations. Reference [7] – “Personnel protection activity plan in case of accident oat Bushehr-1 NPP” deals with threat to NPP personnel, but report lacks information which procedures cover other authorities.
5. The report lists duties of the state and includes organizational scheme of the local emergency response groups and organizational scheme of the offsite radiological protection, however report lacks information which formal procedures define those and whether and how often such arrangements are exercised/ tested.
6. Report provides information on protection management, but lacks information on possible contingencies – e.g. support to EP&R at corporate level, state level that should be also defined via formal procedures.
7. The report provides information regarding accident management procedures, however it has more focus on emergency operational procedures – i.e. those for reactor, turbine, electric installations etc. and very little detail related to EP&R, so this part requires elaboration.



8. Report provides information regarding accident management exercises of BNPP operational staff, but lacks in information for other and external organisations personnel. Report does not provided any information whether those were ever conducted and whether scope and periodicity of those are defined.
9. The report includes very limited information on the possibility to use existing equipment. Table 6-1 lists water inventory, but use of equipment and systems, especially availability and possibility of using those in case of LOOP/SBO is not described.
10. The report provides information regarding the mobile devices already available at BNPP and also planned to be purchased, however currently neither connection points, nor procedures are developed even for equipment already available on-site. Time-frame for purchase of additional equipment is also not defined.
11. Report contains information on assumed time (~ 10 min) needed to bring the mobile devices at place on site, but this needs to be confirmed during real exercises. Report also makes some reservations that “Non-availability of the trailers or debris accumulation on the transfer routes could influence this time estimate.” It is believed that mobile equipment shall have own trailers, so the reason for “non-availability of the trailers” reservation is not clear.
12. Report does not contain information on time needed to deploy mobile devices once available on site. This needs to be checked during real exercises; however the report does not define any time-frames when this could be achieved.
13. The report contains detailed information regarding the current provision for supplies, including inventories of demineralized borated and drinking water and diesel fuel, however, as report notes, corresponding procedures for use of these with mobile equipment need to be developed and included in the training. The mobile pumps could also use sea water as the coolant; however corresponding procedures have to be also developed.
14. The report includes information on current arrangements on management of supplies, however procedures for delivery of fuel to the DGs day fuel tanks still need to be developed and included in the training and drills, however timeframe for the development is not defined. It should be also noted that BNPP plans to purchase other mobile equipment – e.g. for primary circuit, SFP etc, so the plant should define consumption of fuel by additional equipment and evaluate how much fuel is necessary for operation of all DGs and mobile equipment for at least 72 hours.
15. The report contains information on provisions limiting radioactive releases, however in some cases additional analyses are necessary – e.g. rated capacity of hydrogen recombiners to cope with BDBA, containment venting, introduction of EOPs and SAMGs etc.
16. Report provides detailed information on plant communication systems and states that “Communication systems for accident management are placed at ZV.1 building, powered from a dedicated DG”, but “So far, no operating instruction has been

developed for implementation of this DG in emergency conditions.” It is not clear from the report whether ALL communication systems are powered from this DG. Report does not state that communication systems are powered from the I category power supply source, so if that is the case then in case of plant SBO there will be delay in communication between operational personnel; content of section 6.1.2.4 should be checked and updated if required.

17. The report does not provide specific information on potential of radioactive contamination on site during the accident, but recommends carrying out respective analysis. Implementation is defined as Medium Term measure.
18. Report provides information regarding measures that would mitigate the conditions preventing staff from working in the main or secondary control room during the accidents; however such an analysis was not done for BDBA. Timeframe for performing such an analysis is also not defined. Report states that “overpressure in the control rooms is maintained by air supply from the compressed air cylinders” and in other part it states “Air supply of 100 m<sup>3</sup>/min to MCR/ECR rooms provides overpressure at least 20 Pa sufficient to prevent intake of the dangerous substances”; it is doubtful that air cylinders could provide 100 m<sup>3</sup>/min, also flow value for overpressurization of MCR/ECR seems too high.
19. Report provides information on all premises that are to be used by crisis teams for management of the accident, but report also recommends to perform the analysis of the expected radiological situation on the site under conditions of a severe accident and to evaluate the robustness of the given premises against the external hazards. Implementation is defined as Medium Term measure.
20. Report provides information regarding the potential site conditions evoked by external hazards in question that could impair accident management measures, report also recommends to evaluate flood resistance of the Standby Crisis Centre (SCC) located in the basement of the ZV1 building, but time frame for this is not defined.
21. Considering robustness of the MCR/ECR and other crisis centres, except SCC, is ensured against seismic and flood events accident management in case of external hazards like earthquakes and floods could be considered as feasible and efficient. Considering that flood resistance of SCC located in the basement of the ZV1 building is questionable and therefore needs to be evaluated in further detail; however timeframe for this evaluation is not defined; it is also not listed among potential safety improvements. This evaluation is also important from communication point of view as SCC is designated to accommodate plant management and ensure permanent communication with the authorities of Bushehr city, Government authorities, operating organization and INRA/NNSD.
22. Report provides detailed information regarding potential site conditions evoked by external hazards in question that could result in unavailability of power supply. Considering redundancy and availability of additional stationary DGs and mobile DGs management of accidents with this additional equipment could be considered as

feasible and efficient. However connection points and operational procedures for use of additional non-safety systems and mobile DGs are not yet developed/defined. Implementation is defined as Short Term measure. It should be also noted that not all these additional DGs could be credited for operation in seismic conditions as neither diesels themselves, nor buildings where these are located are seismically qualified.

23. Report states that attention needs to be paid to robustness of DC power against extreme external hazards further enhanced by a possibility to recharge the batteries. Implementation is defined as Short Term measure.
24. Report does not provide information on potential failure and assessment of potential instrumentation failure on feasibility and effectiveness of accident management. Report states that current list of parameters, monitoring ranges qualification, availability of the batteries to supply instrumentation or use of additional autonomous means for measurement of important plant parameters will be reassessed after finalization of the SAMGs; Implementation is defined as Medium Term measure.
25. Report does not provide information on acceptance criteria for emergency response organisation.

#### **CONTAINMENT INTEGRITY**

1. Report provides opinion on potential destruction of infrastructure around the NPP. According to it is rather limited; however NPP emergency plan foresees measures for transportation and use of the heavy machines for clearing possible debris and restoring access. Report also recommends performing evaluation of the robustness of the communication means. Implementation is defined as Medium Term measure.
2. The report does not provide specific information on high local dose rates on site or in some areas during the accident, but recommends doing respective analysis. Report provides information on all premises that are to be used by crisis teams for management of the accident, but report also recommends to perform the analysis of the expected radiological situation on the site under conditions of a severe accident and to evaluate the robustness of the given premises against the external hazards; Implementation is defined as Medium Term measure.
3. The report does not provide specific information on potential of radioactive contamination on site during the accident, but recommends doing respective analysis. Implementation is defined as Medium Term measure.
4. The reports describes the approach of using the existing plant systems and corresponding accident management actions for core cooling in case of core melting as described in the BDBA manual. The report does not reflect use of mobile equipment, as neither connection points, nor procedures are established; Implementation is defined as Short Term measure. This issue should be also addressed in SAMGs that are being developed; Implementation is defined as Medium Term measure.
5. Report does not provide description of AM measures after failure of the reactor pressure vessel or elimination of fuel damage/ meltdown in high pressure as currently these phases of severe accident are not addressed neither by the BDBA manual, nor

by any other accident procedures or guidelines. Report refers to generally adopted approach in ensuring core cooling function using all available safety and non-safety systems and proposes installation of new hardware that will increase the probability of the success of the strategies of core cooling. Report recommends carrying out feasibility study of heat transfer to UHS; Implementation is defined as Medium Term measure and development of plan for additional modernisations is defined as Short Term measure.

6. Report states that use of PRZ PORV for RCS depressurization represents deviation from defence in depth principle and reliability to operate in given conditions. Report recommends implementation of additional depressurization line equipped with the diverse isolation valves, as more appropriate solution (feasibility study required, Implementation is defined as Medium Term measure). Report also states that depressurization of the primary circuit will be comprehensively addressed in the new symptom-based SAMGs; Implementation is defined as Medium Term measure.
7. Report did not consider potential hydrogen accumulations in other buildings than containment taken into account in cliff-edge effect analyses, however the report looked at risk of potential hydrogen explosions during containment venting. Report proposed to use plant design ventilation lines (TL09) for containment venting and implementing adequate measures to ensure robustness of venting lines possibly with their inerting; Implementation is defined as Long Term measure.
8. Report indirectly assess suitability and availability of the required instrumentation taken into account in cliff-edge effect analyses. According to the analysis estimated values of HCLPF for instrumentation (sensors) inside the ZA (reactor) building is circa 0.55 g. Availability of instrumentation is defined by seismic stability of buildings where instrumentation is located, but all Seismic Category I building have a margin of at least 0.55 g. Report also indicates that instrumentation could be lost due to long-term unavailability of ventilation. Detailed instructions how to cope with such cases are to be detailed in EOPs and SAMGs being developed.
9. The report provides detailed information on current design provisions for preventing hydrogen deflagration or detonation; however design capacity of the system is sufficient for coping with design basis accidents only. Reports indirectly assesses suitability and availability of the hydrogen concentration monitoring instrumentation. Currently instrumentation is capable to measure concentrations up to 5%, but according to the report in case of BDBAs volumetric concentration could reach up to 20%. To prevent potential hydrogen issue in case of BDBA report recommends reassess and increase capacity of the hydrogen recombiners and extending range of hydrogen concentration monitor; Implementation is defined as Short Term measure; while assessment could be implemented in short term, modernisation of systems themselves is likely to be treated as Long Term measure.
10. Report states that current design does not foresee provisions to prevent over-pressurization of the containment in case BDBA when spray system is not available. It

should be also highlighted that “Analysis of the Bushehr NPP containment localizing functions performance at in-vessel and ex-vessel stages of BDBA” [18] does not include assessment of doses for the population. While SAST report has similar type of analysis for Dukovany NPP, this could not be credited as safety assessment for other type reactor, therefore additional analysis is necessary to perform.

11. Report does not contain information on time before occurrence of cliff-edge effects resulting from current design accident management measures related to re-criticality and on suitability and availability of the instrumentation to identify re-criticality. Report also states that issue of recriticality will be addressed in SAMGs related analyses.
12. The report provides information on Instrumentation applicable for accident management (table 6-6), however it lacks information of environmental qualification of those – i.e. capability to withstand excessive pressure, temperature, radiation and duration of mode. Hydrogen sensors listed in the report have limited by 5% upper level that is not sufficient for BDBA. Report also recommends installation of temperature monitoring in the containment operable during BDBA and assess all instrumentation long-term functioning under BDBA conditions.
13. Report did not provide information on acceptance criteria on the adequacy of severe accident management systems for protection of containment integrity, but provides detailed information on currently available features that prolongs containment integrity, support depressurisation of the primary circuit and ensure habitability of control points, etc.
14. Report refers to assessment of additional equipment for cooling of molten corium after a failure of the reactor vessel and for containment heat removal (such as low-pressure top flooding of molten corium, corium spreading outside the reactor cavity, flooding the bottom of containment annulus, installation of diverse containment heat removal system). Implementation is defined as Long Term measure. Cooling of corium and containment heat removal could be also arranged using mobile DGs and pumps, but connection points and operational procedures for use of additional non-safety systems and mobile DGs are not yet developed/defined. Implementation is defined as Short Term measure.

#### ***Spent Fuel Pool (SFP)***

1. The report provides information and description of design and operational provisions currently in place required for the accident management in the SFP, however according to SAST currently there is no specific BNPP-1 analyses for progression of an accident in the SFP into severe accident conditions. There is no diverse system for flooding/ spraying/ make up the SFP inventory using alternative water supply sources. Report refers to PSA studies that defined the most hazardous mode of operation: Loss of residual heat removal in mode 6 with fuel partial unloading from the reactor to the SFP where uncover of fuel in SFP is expected to take place in ~26-30 hours, however

cliff-edge effect analysis (table 6-7) does not consider this mode of operation. The report should explain why, or take into account this mode.

2. According to report specific analyses of the severe accidents taking place simultaneously in the reactor and in the SFP for BNPP-1 are not available, but from the comparable analyses for standard WWER 1000/V320 reactor it could be concluded that the hydrogen removal system sized for the severe accident in the reactor will be also sufficient for parallel severe accident in SFP. Similar analysis should be also done for BNPP-1 in frame of SAMGs development.
3. According to BNPP design the SFP is located inside the containment and thus restriction of radioactive releases is conditioned by maintaining integrity of the primary containment, however according to SAST currently there is no specific BNPP-1 analyses for progression are located in one confinement, BNPP-1 safety documentation should be amended with analyses that will take into account parallel progression of severe accidents in both.
4. The SAST states that SFP is equipped with the instrumentation required for normal operation only (level/temperature). Radiological parameters could be measured by Confinement instrumentation. Assessment of functioning of instrumentation during beyond design basis conditions including severe accident or external hazards is included in the Potential safety improvements and forecast for further work; Implementation is defined as short-term measure; while assessment could be implemented in short term, modernisation of monitoring system themselves is likely to be treated as Long Term measure.
5. Report refers to description of design provisions currently in place restricting the radioactive releases, namely annulus ventilation system, however use of this system would be possible only when electric power is available (restored, from EDG or mobile DG). Report recommends assess effect of annulus filtered ventilation on radioactive releases during severe accidents; Implementation is defined as Medium Term measure. The report also proposes to assess option of connecting the containment spray system to the mobile sources of coolant for enhancing the wash-out of radioactive substances; Implementation is defined as Medium Term measure.

## 2.3 Detail Comments Related to Each Individual Item

### 2.3.1 Detail Comments on Section 1

ISSUE SHEET		
<b>1. ISSUE IDENTIFICATION</b>	Issue Number	1
	Section Number	1.2.2.1
	Page	23
Facility	BNPP-1	
Issue Title	Stress Test	
<b>2. ISSUE CLARIFICATION</b>		
<u>2.1. Issue Description</u>		
The core cooling function is ensured by combination of the normal operation system functions and safety system functions		
<u>2.2. Comments</u>		
There are no systems in BNPP-1 specifically dedicated to cope with beyond design basis accidents and severe accidents. There are no specific hardware measures to cope with conditions after a failure of the reactor pressure vessel		
<u>2.3. Recommendations</u>		
<u>2.4. References</u>		
(References which are used for the comments and recommendations)		

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	2
Section Number	1.2.2.2
Page	25

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The spent nuclear fuel pool cooling system combines the normal operation system functions and safety system functions

#### **2.2. Comments**

There is no dedicated coolant delivery system to SFP for beyond design basis and severe accident conditions. Measures are envisaged to install a diverse system for flooding (or spraying) the spent nuclear fuel pool, possibly using the mobile sources, as an additional independent line of accident management.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)



## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	3
Section Number	1.2.2.4.3
Page	30

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Physical separation of DGs and their equipment comes from the DG redundancy.

#### **2.2. Comments**

However, the level of separation is not clear from SAST report.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	4
Section Number	1.2.2.4.3
Page	31

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Self-assessment does not deal with extension the original design mission time for DG system

#### **2.2. Comments**

Based on DG design, the time for un-service operation at full load (without maintenance and repair) exceeds 10 days but qualification tests on long-term DG operation are not referenced in SAST report.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	5
Section Number	1.2.2.4.4
Page	32

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

#### **2.2. Comments**

There is one common air cooled DG. It is not redundant. DG and its equipment are located in building different from buildings with ordinary on-site source for back-up power supply.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	6
Section Number	1.2.2.4.4
Page	32

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The SAST report provides basic information regarding the physical protection and design against internal/external hazards. Common DG, its equipment and building has safety class 4 and earthquake resistance category III. Russian standards are referenced.

#### **2.2. Comments**

Plane crash is not considered in the design of common DG.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	7
Section Number	1.2.2.5
Page	35

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Technical information on batteries and power consumers refer to design documentation and FSAR.

#### **2.2. Comments**

Data from real measurements or tests are not mentioned.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	8
Section Number	1.2.2.5
Page	35

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Possibility to re-charge each battery bank is provided.

#### **2.2. Comments**

Currently, there is no alternative possibility to normal re-charging the batteries. It is expected that new mobile DGs will be used to re-charge the batteries in emergencies.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## 2.3.2 Detail Comments on Section 2

ISSUE SHEET			
<b><u>1. ISSUE IDENTIFICATION</u></b>		Issue Number	9
		Section Number	2.1.1
		Page	
Facility	Bushehr Nuclear Power Plant		
Issue Title	Earthquake against which the NPP is designed		
<b><u>2. ISSUE CLARIFICATION</u></b>			
<b><u>2.1. Issue Description</u></b>			
<p>The report mentioned that the evaluations also used the site information related to the Bushehr II NPP, which is located very close.</p>			
<b><u>2.2. Comments</u></b>			
<p>C1. There is no information, which will allow seeing the results and compare those with the ones for BNPP-I.</p>			
<b><u>2.3. Recommendations</u></b>			
<b><u>2.4. References</u></b>			

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	10
Section Number	2.1.1.1
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Characteristics of the design basis earthquake

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

According to IAEA standard that applied at the time of the seismic hazard evaluation two levels of ground motion hazard were evaluated, here named SSE (i.e. SL-2) and DBE (SL-1).

#### **2.2. Comments**

C1. In the report there is no information for the mean PGA estimations for the BNPP site SL-1.

#### **2.3. Recommendations**

#### **2.4. References**



## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	11
Section Number	2.1.1.2
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Methodology used to evaluate the design basis earthquake

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is description of the methodology for the determination of DBE provided?

#### **2.2. Comments**

C1. It is important to have seismic source and magnitude-distance deaggregation description, which is absent.  
C2. Sensitivity analysis is lacking which is used to support the evaluation of the significance of the contributions of the various input data in the model.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	12
	Section Number	2.1.1.2
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Methodology used to evaluate the design basis earthquake	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is the seism-tectonic model described, if applied?

#### **2.2. Comments**

C1. For model SM1-BNPP1 it is not clear whether at the site any seismicity is assumed.  
C2. In all 4 seismic source models (even with R=150km) there are areas without assigned seismic parameters, i.e. no seismic sources are considered, which should be taken into consideration.  
C3. The Persian Gulf did not consider in the source models.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	13
	Section Number	2.1.1.2
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Methodology used to evaluate the design basis earthquake	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is reasoning for choice of seismic past data provided?

#### **2.2. Comments**

C1. The information presented in the report does not fully cover the requirements of paragraph 3.26 of SSG – 9:

“3.26. To the extent possible, the information on each earthquake should include:

- (a) Date, time and duration of the event – no data described;
- (b) Location of the macroseismic epicentre – figure 2-2 present the data of epicenters and magnitude intensity;
- (c) Estimated focal depth - no data provided;
- (d) Estimated magnitude, the type of magnitude (e.g. moment magnitude, surface wave magnitude, body wave magnitude, local magnitude or duration magnitude; see Definitions) and documentation of the methods used to estimate magnitude from the macroseismic intensity – detailed analysis and data provisions of different magnitudes, seismic waves and durations aren't provided.;
- (e) Maximum intensity and, if different, intensity at the macroseismic epicentre, with a description of local conditions and observed damage, no description provided;
- (f) Isoseismal contours – no graphical information as a result of the microseismic models;
- (g) Intensity of the earthquake at the site, together with any available details of effects on the soil and the landscape – completely missing;
- (h) Estimates of uncertainty for all of the parameters mentioned;
- (i) An assessment of the quality and quantity of data on the basis of which such parameters have been estimated – fractal data is presented;
- (j) Information on felt foreshocks and aftershocks - no description provided;
- (k) Information on the causative fault - no description provided.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

Issue Number	14
Section Number	2.1.1.2
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Methodology used to evaluate the design basis earthquake

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

Is information regarding the uncertainty analysis in identification of DBE provided?

#### 2.2. Comments

- C1. In the seismic hazard valuation, all uncertainties -both aleatory and epistemic should be taken into account.
- C2. Determination of the maximum magnitude and the seismicity parameters are presented without introducing uncertainties.
- C3. The instrumental catalogue which was used also allows determining depth and location errors, uncertainties of which also have not been provided.
- C4. Only one seimotectonic model was used, but in logic tree it is provided by 2 branches. Weight for seismicity parameters (magnitude-frequency) are absent.
- C5. The general approach to seismic hazard evaluation should be directed towards reducing the uncertainties at various stages of the evaluation process in order to obtain reliable results driven by data.

#### 2.3. Recommendations

#### 2.4. References

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	15
Section Number	2.1.1.2
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Methodology used to evaluate the design basis earthquake

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is information regarding the added safety margins in identification of DBE provided?

#### **2.2. Comments**

C1. Specific information on how the safety margins have been evaluated is not available.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	16
	Section Number	2.1.1.2
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Methodology used to evaluate the design basis earthquake	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is information regarding the validity of seismic data in time used in identification of DBE provided?

#### **2.2. Comments**

C1. The report does not include discussion on validity of seismic data.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	17
Section Number	2.1.1.2
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Methodology used to evaluate the design basis earthquake

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is information on the site specific database with seismological data provided?

#### **2.2. Comments**

C1. In the report information on the site-specific database with seismological data is not provided, but some results, in particular, site specific spectra were developed for Delvar-Ahram, Delvar-Mand Bora-zjan-Kazerun II seismic zones in the epicentral distances 8, 16 and 36 km from the site.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	18
Section Number	2.1.1.2
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Methodology used to evaluate the design basis earthquake

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is information of site response analysis provided?

#### **2.2. Comments**

C1. There is no information about investigations for obtaining detailed knowledge of the potential for permanent ground displacement phenomena associated with earthquakes (e.g. fault capability, liquefaction, subsidence or collapse due to subsurface cavities).

#### **2.3. Recommendations**

#### **2.4. References**



## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	19
	Section Number	2.1.1.2.1
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Site geology and tectonics	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

According to the report site vicinity faults were searched. But basic design for BNPP was prepared according to the results of two significant seismotectonic models of the region which were designed by A. Nooruzi and Dames & Moore Company specialists in 1970-s.

#### **2.2. Comments**

C1. Recent studies in active tectonics should be taken account too.  
C2. The geological database should be completed especially for the near region, site vicinity and site areas.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	20
	Section Number	2.1.1.2.2
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Database of seismological data and their analysis	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Shahvar et al. (2013) conduct a regional study, where 3 regression methods (SR, ISR and OR) are used and an appropriate model is chosen for each magnitude conversions. Based on the difference of used data magnitude conversion equations, it shows that dispersion can be large, hence applying an equation may have a great impact on a unified earthquake catalogue.

#### **2.2. Comments**

- C1. The maximum magnitude considered in a zone should be at least equal to the maximum observed magnitude increased by its uncertainty.
- C2. Recurrence laws in large areas of the same tectonic environment should be taken into account.
- C3. There is no information about seismicity parameters.

#### **2.3. Recommendations**

- R1. It is recommended to compare some representative magnitudes with evaluated magnitudes by well recognized and known other publications, to show coherency (for instance with Scordilis (2006), in where the data set used contains 20,407 earthquakes, which occurred all over the world during the time period 1976–2003, for which moment magnitudes are available).
- R2. For definition of Mmax it is recommended to use combination of geological and/or paleoseismological data with tectonic environment.

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	21
Section Number	2.1.1.2.3
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Identification of the seismic sources – seismotectonic models

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Developed seismic source models are differing by their radius of the region under study, however only SM1 models were used.

#### **2.2. Comments**

C1. For model SM1-BNPP1 it is not clear whether any seismicity at the site is assumed.  
C2. In all 4 seismic source models (even with  $R=150\text{km}$ ) there are areas without assigned seismic parameters, i.e. no seismic sources are considered, which should be taken into consideration.  
C3. A clear explanation of the background of the used method for the evaluation of the  $M_{\text{max}}$  should be given.

#### **2.3. Recommendations**

R1. It is recommended to develop regional seismotectonic models with a radius of at least 300 km around the site in order to consider the potential influence of all the seismic sources on the seismic motion at the site.

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	22
	Section Number	2.1.1.2.4
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Determination of Earthquake design basis	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

As required by IAEA typically, two levels of ground motion hazard, named SL-1 and SL-2, are defined as the earthquake design basis for each plant. In the report, the mean estimation for the BNPP site SL-2 presented (table 2-1). The result of used three approaches shows 0.4g values. At the same time in figure 2-9 the mean value of UHRS for PGA shows 0.6g for return period of 10.000 (SL-2).

#### **2.2. Comments**

C1. There must be an explanation of this difference.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	23
Section Number	2.1.1.2.5
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Hazard curves and levels of ground motion hazard

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

In the report seismic hazards curves for confidence levels 84% and 50% show 0.4g and 0.25g respectively for return period of 10.000 year (SL-2) (figure 2-7).

#### **2.2. Comments**

C1. It is not consistent neither with the result presented in the table 2-1, nor with value of UHRS. This difference should be explained.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	24
Section Number	2.1.1.2.7
Page	

Facility	Bushehr Nuclear Power Plant
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Issue Title	Treatment of uncertainties
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### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

An acceptable method for propagating the epistemic uncertainties through the probabilistic seismic hazard analysis is the development of a logic tree, which can be evaluated by one of the following methods: (1) complete enumeration of the logic tree branches; or (2) Monte Carlo simulation.

#### **2.2. Comments**

#### **2.3. Recommendations**

R1. It is recommended to pay attention to the Monte Carlo sampling techniques for generating a number of epistemic branches reflecting the range of possibilities, according to the available data to define quantitative values and their associated uncertainties.  
R2. It is recommended to implement Monte Carlo simulations for each main branch to generate secondary branches that allow propagating the uncertainties.

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	25
Section Number	2.1.1.2.8
Page	

Facility Bushehr Nuclear Power Plant

Issue Title Attenuation models

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The selection of Ground Motion Prediction Equations (GMPE) needs to be strongly based on the comparison with the observed strong motion records, and preferably, regional GMPEs need to be used. According to the report three models of attenuation were used in PSHA. Two of them can be considered as site-specific.

#### **2.2. Comments**

C1. Taking into account the comment which concern to the Persian Gulf in seismo-tectonic model section for stable crustal regions GMPEs should be selected separately, taking into account the selection criteria for stable regions (e.g. Akkar & Bommer (2010), Cauzzi & Faccioli (2008), Pezeshk et al. (2011), etc).

#### **2.3. Recommendations**

R1. It is recommended to use also the selection criteria from recent research projects on seismic hazard studies, like SHARE at European scale, or Global Earthquake Model (GEM) at worldwide scale, procedures for selection of GMPEs.

R2. It is suggested to reconsider the weights of GMPEs. More weight can be assigned to local GMPEs.

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	26
Section Number	2.1.1.2.9
Page	

Facility	Bushehr Nuclear Power Plant
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Issue Title	Time histories
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### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

In the report it is mentioned that accelerograms were generated for an earthquake from three source areas for both horizontal and vertical components.

#### **2.2. Comments**

C1. In the report the accelerogram for the strongest earthquake in the Delvar-Ahram zone is shown, while it would be useful to see also comparison of modified and target response spectrum.

#### **2.3. Recommendations**

#### **2.4. References**



## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	27
Section Number	2.1.1.2.10
Page	

Facility Bushehr Nuclear Power Plant

Issue Title Local conditions

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Characteristics of soils of the unit 1 reactor building foundation presented in table 2-7.

#### **2.2. Comments**

C1. There is no information about investigations for obtaining detailed knowledge of the potential for permanent ground displacement phenomena associated with earthquakes (e.g. fault capability, liquefaction, subsidence or collapse due to subsurface cavities).

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	28
	Section Number	2.1.1.2.11
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Safety margins	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report states that specific information on how the safety margins have been evaluated is not available

#### **2.2. Comments**

C1. It is necessary to provide and address this information.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	29
Section Number	2.1.1.2.11
Page	

Facility	Bushehr Nuclear Power Plant
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Issue Title	Safety margins
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### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report also states that safety margin was, in the case of BNPP-1, were defined using the probability of exceedance  $1 \times 10^{-4}$  for 84th percentile value (or median +  $\sigma$ ) and that this approach has been used in the past.

#### **2.2. Comments**

#### **2.3. Recommendations**

R1. It is advisable to make a comparison with the value of the safety margin determined by the current up-to-date approach.

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	30
Section Number	2.1.1.3
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Conclusion on the adequacy of the design basis for the earthquake

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is information regarding the validity of seismic data from the current state-of-the art perspective provided?

#### **2.2. Comments**

C1. Recent studies and publications concerning the study area can be used.  
C2. The new data and information that are available for the construction of the BNPP-2 plant can be used.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	31
Section Number	2.1.1.3
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Conclusion on the adequacy of the design basis for the earthquake

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is assessment of the overall methodology used for identification of DBE from the current state-of-the art perspective provided?

#### **2.2. Comments**

C1. Several different terms that are used for addressing two levels of earthquakes most likely is a consequence of different translations used during writing the English version of the document. The meaning of DBE is different from international terminology (IAEA, WENRA) and can be misleading.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	32
	Section Number	2.1.1.3.2
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Summary	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

In the report, input data and parameters are often presented and described very briefly, the results are contradictory and not clearly described.

#### **2.2. Comments**

C1. Data, analysis and results available for the BNPP-2 plant should be used.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	33
	Section Number	2.1.1.3.3
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Recommendations for updating the seismic hazard analysis	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

#### **2.2. Comments**

#### **2.3. Recommendations**

R1. It is recommended that the Probabilistic Seismic Hazard Analysis (PSHA) logic tree should be more fully developed to fully account for the epistemic uncertainties that exist in the characterization of the seismogenic structures and zones of diffuse seismicity in the regional and local areas around the NPP site.

R2. Shahvar et al. (2013) conduct a regional study, where 3 regression methods (SR, ISR and OR) are used and an appropriate model is chosen for each magnitude conversions. It is recommended to compare some representative magnitudes with evaluated magnitudes by well recognized and known other publications, to show coherency (for instance with Scordilis (2006), in where the data set used contains 20,407 earthquakes, which occurred all over the world during the time period 1976–2003, for which moment magnitudes are available).

R3. It is recommended to show completeness periods for whole catalogue.

R4. There is no description of location error in the report. It is recommended to use information of location error.

R5. Developed seismic source models are differing by their radius of the region under study. It is recommended to develop regional seismotectonic models with a radius at least 300 km around the site in order to consider the potential influence of all the seismic sources on the seismic motion at the site. For model SM1-BNPP1 (figure 1.4) it is not clear whether at the site any seismicity is assumed. In all 4 seismic source models (even with R=150km) there are areas without assigned seismic parameters, i.e. no seismic sources are considered, which should be taken into consideration.

R6. One more recommendation concerns the Persian Gulf, which did not consider in the source models. For example, according to Johnston (1989) the region as stable Africa consists of 4 separate areas (Africa, Saudi Arabia etc.). The Persian Gulf is within the stable crustal zone, in this regard, it could be appropriate to modify Seismotectonic Models by including the mentioned area and assign appropriate seismicity parameters and  $M_{max}$  with their uncertainties according to Johnston (1989).

R7. Determination of the maximum magnitude presented without introducing uncertainties. The maximum magnitude considered in a zone should be at least equal to the maximum observed magnitude increased by its uncertainty. For definition of  $M_{max}$  it is recommended to use combination of geological and/or paleoseismological data with tectonic environment.

R8. Instrumental part of the catalogue allows to determine the depth of earthquake with more or less acceptable accuracy. It is therefore recommended to evaluate the focal depth distribution to justify the basis of the given depths.

R9. The GR b-values in the region of interest are informative. The assigned regional value to the b parameter should be strongly justified. It is also recommended to take into consideration the uncertainty of the seismicity parameters in the logical way.

R10. The selection of GMPEs needs to be strongly based on the comparison with the observed strong motion records, and preferably, regional GMPEs need to be used. For ranking GMPEs, suitable for the seismotectonic context of the region, it is recommended to use also the selection criteria from recent research projects on seismic hazard studies, like SHARE at European scale, or GEM at worldwide scale, procedures for selection of GMPEs.

R11. Disaggregation of the seismic hazard issued from the logic tree should be performed in order to evaluate the respective contribution of seismic sources to the hazard at the site. Disaggregation by magnitude and distance, and the disaggregation by seismic sources should be performed.

R12. It is recommended to implement Monte Carlo simulations for each main branch to generate secondary branches that allow propagating the uncertainties. The choice of the 300 km radius seems appropriate for the regional area, however the background for this choice should be well explained.

#### 2.4. References



## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	34
	Section Number	2.1.2.1
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Identification of SSC that are required for achieving safe shutdown state and are most endangered during an earthquake. Evaluation of their robustness in connection with DBE and assessment of potential safety margin	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Are structures, systems and components that are required for achieving safe shutdown condition for all reactor operational modes identified?

#### **2.2. Comments**

C1. The report is missing table that lists SSCs that are required for achieving safe shutdown condition in different reactor operation modes.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	35
	Section Number	2.1.2.1
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Identification of SSC that are required for achieving safe shutdown state and are most endangered during an earthquake. Evaluation of their robustness in connection with DBE and assessment of potential safety margin	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Are structures, systems and components that are required for providing of safety functions for the spent nuclear fuel storage identified?

#### **2.2. Comments**

C1. It would be useful to introduce additional table listing SSCs that are required for SFP cooling in section 2.1.2.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	36
	Section Number	2.1.2.1
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Identification of SSC that are required for achieving safe shutdown state and are most endangered during an earthquake. Evaluation of their robustness in connection with DBE and assessment of potential safety margin	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is seismic robustness data of SSCs required for providing of safety functions for the spent nuclear fuel storage provided?

#### **2.2. Comments**

C1. The information on seismic resistance of the system components is lacking.

#### **2.3. Recommendations**

R1. It is recommended to include in SAST table similar to table 2-8, but for SFP cooling equipment.

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	37
	Section Number	2.1.2.2
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Main operating contingencies in case of damage that could be caused by an earthquake and could threaten achieving safe shutdown state	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

#### **2.2. Comments**

C1.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	38
Section Number	2.1.2.2
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Main operating contingencies in case of damage that could be caused by an earthquake and could threaten achieving safe shutdown state

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is information regarding any required mobile equipment provided?

#### **2.2. Comments**

C1. Report lists 3 items already purchased by BNPP-1 – mobile diesel generators (2MW 10 kV and 0.2 MW 0.4 kV) and mobile pump with rated capacity Q150@h900 for SG make-up. Other mobile equipment is under consideration. Connection points of already available equipment are not defined.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	39
	Section Number	2.1.2.3.1
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Assessment of potential failures of heavy structures, pressure retaining devices, rotating equipment, or systems containing large amount of liquid that are not designed to withstand DBE and that might be impacted due to internal flood	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is the list of SSCs that can cause a consequential damage to the SSCs required to remain operable following a seismic event provided (taking into account safe shutdown SSCs for reactor and spent nuclear fuel storage)?

#### **2.2. Comments**

C1. The report does not provide list of SSCs that can cause a consequential damage to the SSCs required to remain operable following a seismic event, but refers to Russian document “Detailed seismic walk-down of BNPP 1”. Neither list of equipment nor reference in the list of references are included in SAST.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	40
	Section Number	2.1.2.3.1
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Assessment of potential failures of heavy structures, pressure retaining devices, rotating equipment, or systems containing large amount of liquid that are not designed to withstand DBE and that might be impacted due to internal flood	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Are all possible seismic failure modes for consequential failures of SSCs required to remain operable following a seismic event taking into account in identification of all non-seismic SSCs (e.g., flooding, losing of power supply, physical interaction)?

#### **2.2. Comments**

C1. The report does not include all possible seismic failure modes for consequential failures of SSCs required to remain operable following a seismic event.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	41
	Section Number	2.1.3.1
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Licensee/ operator's processes to ensure that NPP structures, systems and components that are needed for achieving safe shutdown after earthquake, or that might cause indirect effects discussed under 2.1.2.3 remain in operable conditions	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is information regarding the periodic testing programs of safety relevant SSCs related to safe shutdown following a seismic event provided?

#### **2.2. Comments**

C1. The report lists 18 systems' periodic testing programs for systems that are relevant for safe shutdown following a seismic event. YP system is missing among those.

#### **2.3. Recommendations**

#### **2.4. References**



## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	42
	Section Number	2.1.3.1
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Licensee/ operator's processes to ensure that NPP structures, systems and components that are needed for achieving safe shutdown after earthquake, or that might cause indirect effects discussed under 2.1.2.3 remain in operable conditions	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is information regarding the maintenance programs of safety relevant SSCs related to safe shutdown following a seismic event provided?

#### **2.2. Comments**

C1. The report lists 18 systems' maintenance programs for systems that are relevant for safe shutdown following a seismic event. YP system is missing among those.  
C2. 16.BU.1 ZF.RA.AB.WI.ATEX.001 listed twice for different systems.  
C3. Programs 14 and 15 have same title.  
C4. Deficiencies need to be addressed.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	43
	Section Number	2.1.3.3
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Potential deviations from licensing basis and actions to address those deviations	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is information regarding any known deviation from current licensing basis provided?

#### **2.2. Comments**

C1. Report did not provide information on any known deviation from current licensing basis, but rather refer to “Report on safety analyses of Bushehr NPP at extreme external impacts” from May of 2012.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	44
	Section Number	2.1.3.3
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Potential deviations from licensing basis and actions to address those deviations	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is information regarding the consequences for each identified deviation in terms of impact on NPP design safety provided?

#### **2.2. Comments**

C1. Report did not provide information on any known deviations.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	45
	Section Number	2.1.3.3
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Potential deviations from licensing basis and actions to address those deviations	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is information whether any specific compliance check has already been initiated following the Fukushima NPP accident provided?

#### **2.2. Comments**

C1. Report did not provide information on any additional compliance checks except SAST review.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	46
Section Number	2.2.1
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Range of earthquake leading to severe fuel damage

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is information regarding the NPP's response to earthquake provided for a large range of postulated earthquake intensities?

#### **2.2. Comments**

C1. According to section 2.2.1.4.2 three Seismic Category I plant components could not withstand  $0.2 \text{ g} < \text{PGA} < 0.40 \text{ g}$  earthquake- i.e. GY10,20,30,40B002; TH50-70 flanged connection bolts and TW10,20,30B003,004. Report did not mention any measures aimed at elimination of these deficiencies among recommendations for safety enhancements.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	47
Section Number	2.2.1
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Range of earthquake leading to severe fuel damage

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is assessment of seismic response with respect to the provision of fundamental safety functions provided for the reactor and for the spent nuclear fuel storage?

#### **2.2. Comments**

C1. Spent nuclear fuel storage (pool) has not been discussed enough in the provided report.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	48
Section Number	2.2.1
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Range of earthquake leading to severe fuel damage

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Is assessment of fundamental safety functions provision for the reactor and spent nuclear fuel storage performed to such earthquake intensities at which severe damage to the fuel becomes unavoidable?

#### **2.2. Comments**

C1. No for the spent nuclear fuel pool.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	49
Section Number	2.2.1.1
Page	

Facility Bushehr Nuclear Power Plant

Issue Title Approach

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

#### **2.2. Comments**

- C1. The report lacks list of SSC required for achieving safe shutdown during an earthquake.
- C2. Section 2.1.2.1. Identification of SSC that are required for achieving safe shutdown state and are most endangered during an earthquake includes classification of system, but not list of SSCs.
- C3. This report is not expected to include SSCs functions during and after earthquake.

#### **2.3. Recommendations**

#### **2.4. References**



## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	50
	Section Number	2.2.1.2
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Identification of success paths	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Identification of success paths, to ensure of the fundamental safety functions is performed for induced initiators associated with Nuclear Steam Supply System (NSSS) failure (reactor, primary loop, steam lines) and for loss of offsite power.

#### **2.2. Comments**

C1. Report does not include similar discussion about ensuring fundamental safety functions for SFP.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	51
Section Number	2.2.1.3
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Methodology used for the estimation of seismic margin

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The methodology used for the estimation of seismic margin is relevant and correspond to the current internationally recognized standards. Detailed information regarding the seismic hazards follows the principles proposed in the SSG - 9 Seismic Hazards in Site Evaluation for Nuclear Installations.

#### **2.2. Comments**

C1. SSC analysis can be presented in a better format regarding the seismic safety margins using a more detailed verification results in the form of probabilistic parameters.  
C2. Report does not provide evidence on possible impact of nearby SSC with lower seismic category and vulnerability on the first category SSCs.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	52
Section Number	2.2.1.4
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	The evaluation of plant level seismic margin

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Evaluation of plant level seismic margin is provided within 2.2.1.4.1 to 2.2.1.4.6 for ranges of earthquakes from 0.1g to more than 0.6g PGA. The seismic response with respect to the provision of fundamental safety functions (for the reactor) is discussed in detail.

#### **2.2. Comments**

C1. The report lacks detailed, same way evaluation of SFP.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	53
Section Number	2.2.1.5
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Conclusion regarding the seismic core damage margin – cliff edge effect

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Based on the seismic margin evaluation it is considered that seismic levels at which core damage would be likely are at HCLPF range from 0.55 g to 0.60 g.

#### **2.2. Comments**

C1. The report does not include any discussion about cliff-edge effects for the spent nuclear fuel pool (SFP).

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	54
	Section Number	2.2.2
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Range of earthquake leading to loss of containment integrity	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Are any NPP's containment construction weak points identified for any of analysed earthquake intensity ranges?

#### **2.2. Comments**

C1. In 2.2.1.4.6 - HCLPF value for Reactor building (1ZA/B) is about 0.60 g, foundation soil failure is the expected mode of failure.  
No defined weak points of the containment structures.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	55
Section Number	2.2.2
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Range of earthquake leading to loss of containment integrity

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Are any cliff-edge effects related to containment structure identified for any of analysed earthquake intensity ranges?

#### **2.2. Comments**

C1. Cliff-edge effect has not been identified for the primary containment due to its extremely high seismic capacity, as described in section .2.2.2.3.3

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	56
	Section Number	2.2.2.1
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Identification of success paths	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report includes a short description of the success paths in performance of fundamental safety function associated with the containment integrity.

#### **2.2. Comments**

C1. It will be useful to be provided more details on success pass for containment, i.e. similar as for earthquake resulting in fuel damage or refer to it if those are same.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	57
	Section Number	2.2.2.3.1
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Earthquakes in the range of PGA < 0.40 g.	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report states that “Capacity of the containment structure is much higher than acceleration value within this range”.

#### **2.2. Comments**

C1. This statement need to be supported by specific referenced documents, reports, or analysis.

#### **2.3. Recommendations**

#### **2.4. References**



## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	58
Section Number	2.2.2.3.2
Page	

Facility Bushehr Nuclear Power Plant

Issue Title Earthquakes in the range of  $0.40\text{ g} < \text{PGA} < 0.60\text{ g}$ .

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report states that “Scenario with a combination of LOCA caused by seismic motion has been analysed in the simple finite element analysis. In this conservative scenario LOCA is induced at the beginning of the strong ground motion period, containment is pressurized to 0.36 MPa and subjected to the seismic motion. For this load combination, HCLPF of the primary containment was evaluated as 0.55g.”

#### **2.2. Comments**

C1. No references to report or analysis.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	59
Section Number	2.2.2.3.3
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Earthquakes in the range of PGA > 0.60 g.

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report states that the real seismic capacity of the steel containment structure is higher than 1 g and the capacity of all isolation valves is higher than specified values.

#### **2.2. Comments**

C1. No provided references to reports, analysis, seismic calculations, etc.

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	60
	Section Number	2.2.3
	Page	
Facility	Bushehr Nuclear Power Plant	
Issue Title	Earthquake exceeding design basis earthquake for the NPP and consequent flooding exceeding design basis flood	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Are any cliff-edge effects related to potential flooding exceeding beyond design basis flood caused by an earthquake identified?

#### **2.2. Comments**

C1. No discussion about possible tsunami

#### **2.3. Recommendations**

#### **2.4. References**

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	61
Section Number	2.2.4
Page	

Facility	Bushehr Nuclear Power Plant
Issue Title	Measures envisaged increasing robustness of the NPP against earthquakes

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Are any provisions that can be envisaged to prevent identified cliff-edge effects or to increase robustness of the NPP (modifications of hardware, modification of procedures, organisational provisions) provided?

#### **2.2. Comments**

C1. While report lists in section 2.2.4.1.1 seven measure for hardware modification, two for procedures and seismic hazard reassessment report did not provide information on what was the basis for these recommendations and did not refer to any analysis or study that defined those.

C2. Systematic approach should be used for this, all potential weaknesses have to be identified and reflected in the SAST Report.

#### **2.3. Recommendations**

#### **2.4. References**

### 2.3.3 Detail Comments on Section 3

ISSUE SHEET		
<b><u>1. ISSUE IDENTIFICATION</u></b>	Issue Number	63
	Section Number	3.1.1.1
	Page	65
Facility	BNPP-1	
Issue Title	Stress Test	
<b><u>2. ISSUE CLARIFICATION</u></b>		
<b><u>2.1. Issue Description</u></b>		
<b><u>2.2. Comments</u></b>		
There is no information in SAST report regarding the difference in DBF in the original and current licensing basis.		
<b><u>2.3. Recommendations</u></b>		
<b><u>2.4. References</u></b>		
(References which are used for the comments and recommendations)		

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	64
Section Number	3.1.1.2
Page	66

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Methodology for the estimation of site characteristics and the determination of design basis floods (DBF) is described in SAST report in general. In principle, two basic approaches were applied to develop the site characteristics – deterministic and probabilistic one. The SAST report provides limited information about the establishment of the team, collection and processing of data, identification of events (sources of flood) and their screening, development of site characteristics and flooding model, design basis flood (beyond design basis flood), and results and their evaluation.

#### **2.2. Comments**

Implemented technics, models, assumptions, conditions or parameters, criteria and justifications are not described in SAST report.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	65
Section Number	3.1.1.2
Page	66

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Methodology for the estimation of site characteristics and the determination of design basis floods (DBF) is described in SAST report in general. In principle, two basic approaches were applied to develop the site characteristics – deterministic and probabilistic one. The SAST report provides limited information about the establishment of the team, collection and processing of data, identification of events (sources of flood) and their screening, development of site characteristics and flooding model, design basis flood (beyond design basis flood), and results and their evaluation.

#### **2.2. Comments**

However, the hydrological studies for Bushehr 1 were elaborated in 1997 year. They are considered outdated in regard to implemented methodology, used meteorological and hydrological data, so the report recommends updating those.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	66
Section Number	3.1.1.2
Page	66

Facility BNPP-1

Issue Title ....

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

A review of flood due to extreme precipitations was done in the frame of SAST and documented. It is concluded that hydrological surface runoff calculations (maximum flow rate, and runoff volume) were performed for maximum daily precipitations with probability of occurrence 10-2/year, 10-4/year and probable maximum precipitations (PMP). Determination of rated hydrological characteristics refers to a document issued in 1984. The height of runoff layer is reported generally for the total catchment area and for all design rainfalls.

#### **2.2. Comments**

Variability in rain intensity over the day is not considered.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)



## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	67
Section Number	3.1.1.2
Page	66

Facility BNPP-2

Issue Title ....

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Modelling assumptions and boundary conditions are justified. The NPP was designed to withstand flood impact with the drainage system out of operation (clogged inlets), so site drainage system is considered plugged.

#### **2.2. Comments**

Uncertainties are not fully evaluated. The implemented model should be updated based on hydrological modelling using currently available meteorological data.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	68
Section Number	3.1.1.2
Page	68

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Hydrological study was elaborated in 1997 and the input data used in the study are more than 20 years old. New studies have been published regarding the tsunami hazard in Persian Gulf. They proved that the tsunami generated by landslides could be more serious than the tsunami generated by earthquake itself

#### **2.2. Comments**

It is recommended to reassess hazard levels and margins for external events at least every 10 years and update the hydrological study using methodology in compliance with IAEA standard SSG-18.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	69
	Section Number	3.1.1.2
	Page	70
Facility	BNPP-1	
Issue Title	Stress Test	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The SAST report concludes that the uncertainty/sensitivity analyses in identification of site characteristics and consequent determination of DBF are not performed in full scope.

#### **2.2. Comments**

The impact of inputs and assumptions on the calculated results is not provided. It is not known what quantile (median, mean, or any other) represents the site characteristics used for determination of DBF (to use of confidence level higher than the median of the hazard curve is expected according to WENRA reference levels T 2.2).

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	70
Section Number	3.1.1.2
Page	70

Facility	BNPP-1
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Issue Title	Stress Test
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### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

#### **2.2. Comments**

It is not described how the site characteristics were transferred into DFB characteristics for all types of considered floods. Safety margin incorporated into the DBF determination for extreme precipitations is not evaluated.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	71
Section Number	3.1.1.3
Page	70

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Site characteristics for flooding caused by extreme precipitations use site specific data from time period 1951-1995 (-2010). Site characteristics for flooding caused by sea use regional data from Persian Gulf.

#### **2.2. Comments**

Site evaluation uses the methodology and knowledge that was known at the time of the evaluation, which does not fully correspond to current knowledge and practices used.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	72
Section Number	3.1.1.3
Page	70

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The review identified missing uncertainty and sensitivity analyses, physical phenomena that have a potential to increase the height of flood are not fully covered and site flooding model is too simple

#### **2.2. Comments**

The model does not take into account variability in rain intensity over the day or morphology of the site.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	73
Section Number	3.1.1.3
Page	71

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

There is a recommendation in SAST report to update the site characteristics in the next Periodic Safety Review (PSR) to be in line with best available knowledge and state-of-the-art methodology.

#### **2.2. Comments**

Impact of update of site characteristics on DBF is not discussed in the SAST report.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	74
	Section Number	3.1.1.4
	Page	71
Facility	BNPP-1	
Issue Title	Stress Test	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The Bushehr NPP 1 has identified site relevant events with a potential to flood the site, developed site characteristics and determined design basis flood and probable maximum precipitation (PMP). The DBF is expressed in technical parameters and can be caused by extreme precipitations or high sea water level. The DBF is determined for the frequency of occurrence  $10^{-4}$ /year, and PMP for the frequency of occurrence less than  $10^{-4}$ /year.

#### **2.2. Comments**

Uncertainties of DBF are not provided.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)



## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

Issue Number	75
Section Number	3.1.1.4
Page	72

Facility	BNPP-1
Issue Title	Stress Test

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

The SAST reviewed the methodology used for identification of events resulted in the potential site flooding, screening of the events, development of site characteristics, site flooding, and determination of DBF from the current state-of-the art perspective. Among the sources of flood, sea and extreme precipitations are considered relevant for the site and analysed in depth. In principle, two basic methods were applied in detailed analysis – deterministic and probabilistic one. Gumbel's distribution function was used as the most conservative to get to the probabilistically developed site characteristics of extreme precipitations. Deterministically developed characteristics for high sea water level take into account tsunami, tide, storm, slope slides, etc.,

#### 2.2. Comments

but not all physical phenomena that have a potential to increase the height of flood are adequately covered in the light of new knowledge and recent practices. Changes in site flooding due to climatic evolution are not taken into account. The site flooding model is limited. In addition, sensitivity and uncertainty analyses were not fully conducted to evaluate the impact of inputs and assumptions on calculated results.

#### 2.3. Recommendations

#### 2.4. References

(References which are used for the comments and recommendations)

## ISSUE SHEET

## 1. ISSUE IDENTIFICATION

Issue Number

76

Section Number

3.1.2.2
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Page

75	
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Facility

BNPP-1

Issue Title
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## Stress Test

## 2. ISSUE CLARIFICATION

## 2.1. Issue Description

## 2.2. Comments

Relevant surveillance programmes associated with design and construction provision included in the NPP design to protect the site against flooding are not mentioned in the self-assessment. They were not developed

### 2.3. Recommendations

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## 2.4 References

2.7. References

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	77
Section Number	3.1.2.2
Page	75

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Information regarding required mobile and non-permanent equipment is provided. At present 2.0 MW and 0.2 MW mobile diesel generators (MDG) are stored in an open area on the site on the platform +7.3 m above MSL. Furthermore, new location on the higher platform of +8.5–9.5 m above MSL is envisaged for MDG placement in the future. This new platform is a small hill with slopes, so the water will not accumulate there

#### **2.2. Comments**

It is not clear, who will use the MDG and how they will be connected

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	78
Section Number	3.1.2.3
Page	76

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The self-assessment mentions general instructions where operating procedures for NPP personnel in case of accident and emergency situations are provided

#### **2.2. Comments**

There are currently no procedures describing operating provisions dedicated specifically to the flood event.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	79
	Section Number	3.1.2.3
	Page	76
Facility	BNPP-1	
Issue Title	Stress Test	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The self-assessment deals with mobile and non-permanent equipment for prevention of flood impact to the NPP. The main force to take appropriate measures in case of flooding is fire brigade located near the site. The staffs of fire brigade is equipped with means of personal protection, fire trucks and a mobile pump for prevention and mitigation of flood consequences or supply see water for cooling.

#### **2.2. Comments**

The NPP self-assessed that at present, there is no heavy machine capable for debris removal available

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	80
Section Number	3.1.2.4
Page	78

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The SAST report provides outcomes of self-assessment of the impact of flooding on NPP surroundings as restoration of capabilities to bring personnel and equipment to the site essential for successful mitigation of accidental situation. Information is limited to a description of surroundings, settlements and access roads.

#### **2.2. Comments**

Following SAST report there are no railroads or waterways of common purpose, rivers, bridges or natural obstacles near the site, which could hint the access to the NPP

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	81
Section Number	3.1.3.3
Page	81

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

In the “Report on safety analyses of Bushehr NPP at extreme external impacts” from May of 2012 there are several conclusions on enhancing safety and resistance of BNPP to external impacts and mitigation of BDBA. Since then some of those recommendations have been implemented such as increasing capacity of DGs (two DGs has been purchased), increasing number of fire trucks and implementing a satellite telephone in the BNPP.

#### **2.2. Comments**

Nevertheless, there is no post-Fukushima measure listed in the report which is directly connected to the flood event

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	82
Section Number	3.2.1
Page	84

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

NPP design's weak points and corresponding cliff-edge effects according to flooding severity are identified. Report states that 1ZE building has entrances below postulated water level and has doors with undefined permissible leakage

#### **2.2. Comments**

These doors are not watertight and may allow for water ingress that might result in flooding of the underground part of the building together with the first floor up to 356 mm above the ground.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)



## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	83
	Section Number	3.2.1
	Page	84
Facility	BNPP-1	
Issue Title	Stress Test	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

While report states that “basement areas of the building could be gradually flooded, but loss of electrical and I&C function is not expected for flooded cables due to their construction properties”

#### **2.2. Comments**

it does not indicate any recommendations on elimination of this deficiency for 1ZE building (e.g. installation of level alarms, water screens, drainage pumps etc).

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	84
Section Number	3.2.2
Page	85

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The NPP response to flooding is carried out for postulated range of water levels.

#### **2.2. Comments**

Timing between flood warning and flooding of the NPP site itself is not taken into account in the results.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

	Issue Number	85
	Section Number	3.2.2
	Page	85-87
Facility	BNPP-1	
Issue Title	Stress Test	

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

There are several areas for improvement of the existing NPP. They cover hydrological and other studies, organizational measures, and flood barriers.

#### 2.2. Comments

##### a) Hydrological and other studies

The hydrological studies are based on outdated meteorological and hydrological data and non-actual methodology. The studies should be updated to cover current international practice:

- Flooding due to extreme precipitation

- o To update meteorological data on rainfall so the long-term series from 1951 up today will be established,

- o To determine the design basis precipitation with the return period of 1 in 10000 years based on updated meteorological data (extreme 24 hour rainfall with varying intensity, rainfall distribution and also consider shorter duration with higher intensity),

- o To use mathematical tests for selection of the most appropriate statistical distribution for the data sets,

- o To use of confidence level higher than the median of the hazard curve is expected according to WENRA reference levels T 2.2,

- o To consider changes due to climatic evolution should be taken into account and possible consequences in relation to meteorological extremes should be considered for the planned operating lifetime of the plant,

- o To verify the land distribution into sub-basins (catchments areas) and include the effects of changes in land use based on geodetic survey and general layout,

- o To elaborate a hydrological model considering following activities

- determination of soil absorption loss and effective rainfall,

- calculation of effective rainfall transformation to surface runoff, the drainage system is completely disabled due to blocked inlets,

- surface run-off adjustment due to accumulation of water in reservoirs and terrain depression,

- determination of maximum height of the run-off layer in each catchment area,

- evaluation of uncertainties by conducting a sensitivity study in deterministic and statistical approaches; this can be done by evaluating the possible range and level of uncertainty in input parameters and in the data used by the models and testing the degree to which the prediction of hazards is affected by varying the values of relevant parameters over their possible ranges,

- Flooding due to high sea water level in Persian Gulf

o to update the design basis sea water level during extreme condition based on the same methodology but using updated data series,  
o to cover the changes due to climatic evolution and to evaluate uncertainties,

### 2.3. Recommendations

### 2.4. References

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	86
Section Number	3.2.2
Page	87

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Organizational measures

As part of the protection concept the appropriate administrative measures, notably monitoring and alert processes should be used besides permanent measures to provide advance warning of the onset of natural hazard events or to monitor the development of the natural event. The monitoring systems should be able to measure events more severe than the design basis without failing or saturating and should be qualified accordingly. National monitoring systems in addition to the equipment on-site should be utilized as well. Thresholds (intervention values) should be defined to facilitate the timely initiation of protective measures. Also corresponding operational procedures should be developed for plant personnel in order to define the necessary scope of protective measures.

#### **2.2. Comments**

Procedures for flooding event should cover all the actions taken from the time of warning (preparation for flood – temporary barriers, closing doors and hatches, checking the street water inlets etc.) up to mitigation of the flood consequences (draining of the rooms using pumps, checking the accessibility of roads etc.).

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	87
Section Number	3.2.2
Page	87-88

Facility	BNPP-1
Issue Title	Stress Test

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Flood barriers  
Following measures regarding flood barriers are recommended:

#### **2.2. Comments**

To test the water tightness of pipe penetrations through the walls of rooms with service water cooling pumps,  
o To perform analysis and implement corresponding measures as necessary to prevent water ingress into the channels through the covers,  
o To verify design arrangement of couplings connecting outer drainage system with inner drains of buildings important to safety; implementation of backward preventers has to be prepared in case of direct gravitational connection.

#### **2.3. Recommendations**

#### **2.4. References**

(References which are used for the comments and recommendations)

## 2.3.4 Detail Comments on Section 4

ISSUE SHEET			
<b>1. ISSUE IDENTIFICATION</b>		Issue Number	88
		Section Number	4.1.1
		Page	189
Facility	BNPP-2		
Issue Title	-----		
<b>2. ISSUE CLARIFICATION</b>			
<u>2.1. Issue Description</u>			
<p>The used data were measured at meteorological stations located near Bushehr and cover a time period exceeding 40 years.</p>			
<u>2.2. Comments</u>			
<p>C1. Information on the site specific database with meteorological events are not enough</p>			
<u>2.3. Recommendations</u>			
<p>R1. R2. ....</p>			
<u>2.4. References</u>			
<p>(References which are used for the comments and recommendations)</p>			

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	89
Section Number	4.1.1
Page	

Facility BNPP-2

Issue Title ....

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The SAST report mentions a use of historical data to develop the site characteristics

#### **2.2. Comments**

C1.  
No measured extremes are listed in SAST

#### **2.3. Recommendations**

R1.

#### **2.4. References**

(References which are used for the comments and recommendations)



## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	90
Section Number	4.1.1
Page	

Facility BNPP-2

Issue Title ....

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The SAST report concludes that the uncertainty/sensitivity analyses in identification of site characteristics and consequent determination of DB characteristics are not performed in full scope. The impact of inputs and assumptions on the calculated results is not provided.

#### **2.2. Comments**

C1.  
It is not known what quantile (median, mean, or any other) represents the site characteristics used for determination of DB (to use of confidence level higher than the median of the hazard curve is expected according to WENRA reference levels T 2.2).

#### **2.3. Recommendations**

R1. Correct it

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	91
Section Number	4.1.1
Page	

Facility BNPP-2

Issue Title ....

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Site characteristics for extreme meteorological events use site specific data from time period 1951-1995 (-2010). Site evaluation uses the methodology and knowledge that was known at

#### **2.2. Comments**

C1.  
The review identified missing uncertainty and sensitivity analyses. Changes due to climatic evolution should be taken into account and possible consequences in relation to meteorological extremes should be considered for the planned operating lifetime of the plant.

#### **2.3. Recommendations**

R1.  
Update the site characteristics in the next Periodic Safety Review (PSR) to be in line with best available knowledge and state-of-the-art methodology.

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	92
Section Number	4.1.2
Page	

Facility BNPP-2

Issue Title ....

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Important from the point of view of safety consequence are the combinations “earthquake + flooding” and “high winds + flooding”.

#### **2.2. Comments**

C1.  
The selected meteorological events correspond to the site conditions; however the process of screening of the hazards and their combinations is not properly described and documented in the study on meteorological hazards and FSAR. Characteristics of the hazard combinations are not clearly identified (results of uncertainty/sensitivity analyses, added safety margin, comparison of estimated results against historical data).

#### **2.3. Recommendations**

R1.  
It is recommended to re-assess the external hazards and combination of hazards in the next periodic safety review implementing state-of-the-art methodology and available data. The analysis should consider causally linked hazards and credible combinations of non-causally linked hazards. The site characteristics should be adequately justified and documented.

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number 93

Section Number 4.2

Page

Facility BNPP-2

Issue Title ....

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

For evaluation of extreme values of meteorological variables, the interrupted data sets for long period were used.

#### **2.2. Comments**

C1.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number 94

Section Number 4.2

Page

Facility BNPP-2

Issue Title ....

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Warnings and meteorological conditions are sent to the BNPP through the meteorological centres.

#### **2.2. Comments**

C1. There is no independent monitoring and alerting systems for meteorological event at BNPP;

#### **2.3. Recommendations**

R1.

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	95
Section Number	4.3.1
Page	

Facility BNPP-2

Issue Title ....

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The self-assessment concluded that is not clear, whether the impact of tornadoes (pressure drop) on heat, ventilation and air conditioning system (HVAC) was adequately analysed.

#### **2.2. Comments**

C1.

#### **2.3. Recommendations**

R1.  
Carry out detailed analyses of the above-mentioned phenomena and its effects on HVAC system.

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	96
Section Number	4.3.1
Page	

Facility BNPP-2

Issue Title ....

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Extreme hot air and seawater temperature, extreme precipitations or dust storm represent meteorological phenomena that develop relatively slowly and can be reasonably predicted by weather forecast. For such phenomena, the preventive measures can be prepared some time in advance

#### **2.2. Comments**

C1.

#### **2.3. Recommendations**

R1.  
It is recommended to establish the appropriate monitoring and alert processes and operational measures to support protection against extreme meteorological phenomena.

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	97
Section Number	4.3.2
Page	

Facility BNPP-2

Issue Title ....

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Timing between extreme weather conditions warning and extreme weather impact of the NPP site itself is not taken into account in analyses in the results. Monitoring and alert systems for extreme meteorological phenomena is not foreseen by the design.

#### **2.2. Comments**

C1. Timing between extreme weather conditions warning and extreme weather impact of the NPP site itself is not taken into account in analyses in the results  
C 2. Monitoring and alert systems for extreme meteorological phenomena is not foreseen by the design.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

(References which are used for the comments and recommendations)



### 2.3.5 Detail Comments on Section 5

ISSUE SHEET			
<b><u>1. ISSUE IDENTIFICATION</u></b>		Issue Number	98
		Section Number	5.1.1.2
		Page	217
Facility	BNPP-2		
Issue Title	Autonomy of the on-site power sources and provisions taken to prolong the service time of on-site AC power supply		
<b><u>2. ISSUE CLARIFICATION</u></b>			
<b><u>2.1. Issue Description</u></b>			
The tanks with diesel fuel located outside of BNPP site are categorized in III seismic category.			
<b><u>2.2. Comments</u></b>			
C. The mentioned tanks could not be credited for strong seismic impacts.			
<b><u>2.3. Recommendations</u></b>			
<b><u>2.4. References</u></b>			
"Regulations on stress tests of NPPs"			

## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

Issue Number	99
Section Number	5.1.1.2
Page	217

Facility	BNPP-2
Issue Title	Autonomy of the on-site power sources and provisions taken to prolong the service time of on-site AC power supply

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

This autonomy can be prolonged to more than 72 hours using consecutive operation of individual EDGs or after makeup of the intermediate storage tanks using a tanker truck located outside BNPP by the means independent from power supply. This sentence should be revised.

#### 2.2. Comments

C. Based on section 5.1.b of "Regulations on stress tests of NPPs" the fuel capacity of intermediate storage tanks should be enough to be prolonged using of the mobile means up to 72 hours and it is not mentioned in the text.

#### 2.3. Recommendations

#### 2.4. References

"Regulations on stress tests of NPPs"

## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

	Issue Number	100
	Section Number	5.1.2.1
	Page	218
Facility	BNPP-2	
Issue Title	Design provisions taking into account this situation: diverse permanently installed AC power sources and/ or means to timely provide other diverse AC power sources, capacity and preparedness to take them in operation	

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

The other diverse AC back-up sources not associated with external grid connection include five air cooled 4.2 MW 10 kV and three air cooled 2.1 MW 10 kV DGs, however those are installed in Seismic Category III building and two MDGs - 2MW 10kV and 0.2 MW 0.4 kV were purchased by the plant.

#### 2.2. Comments

C1. Five air cooled 4.2 MW 10 kV and three air cooled 2.1 MW 10 kV DGs are not protected from excessive rainfall or flooding.  
C2. Neither connection points nor procedures for using Two 2MW 10kV and 0.2 MW 0.4 kV MDGs are available.

#### 2.3. Recommendations

#### 2.4. References

"Regulations on stress tests of NPPs"

## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

	Issue Number	101
	Section Number	5.1.2.1
	Page	218
Facility	BNPP-2	
Issue Title	Design provisions taking into account this situation: diverse permanently installed AC power sources and/ or means to timely provide other diverse AC power sources, capacity and preparedness to take them in operation	

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

Impact of extreme floods was not considered in qualification of the common EDG.

#### 2.2. Comments

C1. Impact of extreme floods should be considered in qualification of the common EDG.

#### 2.3. Recommendations

#### 2.4. References

"Regulations on stress tests of NPPs"

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	102
	Section Number	5.1.2.1
	Page	218
Facility	BNPP-2	
Issue Title	Design provisions taking into account this situation: permanently installed diverse back-up AC power sources and/ or means to timely provide other diverse AC power sources, capacity and preparedness to take them in operation, robustness of the provisions in connection with seismic events and flooding"	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The amount of diesel fuel in the supply tank allows MDGs operation at the rated power for at least 8 hours and the amount of oil allows operation for at least 7 days (168 hours) for 2.0 MW DG and for at least 72 hours for 0.2 MW MDG.

#### **2.2. Comments**

C. It is not mentioned how to obtain the needed amount of diesel fuel to prolong using of mobile diesel generators up to 72 hours.

#### **2.3. Recommendations**

R1. ....

#### **2.4. References**

"Regulations on stress tests of NPPs"

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	103
Section Number	5.1.2.2
Page	221

Facility	BNPP-2
Issue Title	Battery redundancy, diversity, capacity, duration and possibilities to re-charge batteries

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report indicates that battery depletion time is in range of 2 hours, with potential extension to 3 hours in case of loads shedding and report states about intention to use 0.2 MW MDG for recharging batteries in case of SBO

#### **2.2. Comments**

C1. Procedure to extend the depletion battery time is not available.  
C2. Procedure to use 0.2 MW MDG for recharging batteries in case of SBO is not available.

#### **2.3. Recommendations**

R1. ....

#### **2.4. References**

"Regulations on stress tests of NPPs"

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	104
Section Number	5.1.2.2
Page	221

Facility	BNPP-2
Issue Title	Battery redundancy, diversity, capacity, duration and possibilities to re-charge batteries

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Time for connecting MDGs and offsite DGs (five 4.2 MW 10 kV and three 2.1 MW 10 kV) is not specified as those connections were never tested and procedures to use those and MDGs connection points are not yet identified

#### **2.2. Comments**

C1. Connections of MDGs and offsite DGs (five 4.2 MW 10 kV and three 2.1 MW 10 kV) should be tested to specify time of connecting MDGs.  
C2. Procedures to use those and MDGs connection points should be identified.

#### **2.3. Recommendations**

R1. ....

#### **2.4. References**

"Regulations on stress tests of NPPs"

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	105
Section Number	5.1.2.3
Page	222

Facility BNPP-2

Issue Title Actions foreseen to arrange exceptional AC power supply from transportable or dedicated off-site source

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Two MDGs - 2MW 10kV and 0.2 MW 0.4 kV were purchased by the plant.

#### **2.2. Comments**

C1. . Neither connection points nor procedures for using Two 2MW 10kV and 0.2 MW 0.4 kV MDGs are available

#### **2.3. Recommendations**

R1. ....

#### **2.4. References**

"Regulations on stress tests of NPPs"



## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	106
Section Number	5.1.2.3
Page	222

Facility BNPP-2

Issue Title Actions foreseen to arrange exceptional AC power supply from transportable or dedicated off-site source

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Offsite AC back-up sources located in the vicinity of the plant include five air cooled 4.2 MW 10 kV and three air cooled 2.1 MW 10 kV DGs. Report states that they are connected to 10 kV busbars.

#### **2.2. Comments**

C1. Five air cooled 4.2 MW 10 kV and three air cooled 2.1 MW 10 kV DG are not protected from excessive rainfall or flooding.

C2. Mentioned DGs were never tested to provide power.

C3. There is not any figure to show the connections between DGs and 10 kV busbars.

C4. Procedure to use connections is not available and connection points are not defined.

#### **2.3. Recommendations**

R1. ....

#### **2.4. References**

"Regulations on stress tests of NPPs"

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	107
	Section Number	5.1.2.6
	Page	227
Facility	BNPP-2	
Issue Title	Consideration of extreme meteorological events (storms, dust, fog and sultry, heavy rainfall, etc.) impact on loss of electrical power	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report indicates that plant safety important buildings are designed to withstand extreme meteorological events

#### **2.2. Comments**

C. Impact of extreme wind, hurricane, tornado and extreme rainfall so far were not studied for plant power distribution system components

#### **2.3. Recommendations**

R1. ....

#### **2.4. References**

"Regulations on stress tests of NPPs"

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	108
Section Number	5.1.3
Page	227

Facility	BNPP-2
Issue Title	"Loss of off-site power and loss of the ordinary back-up AC power sources, and loss of permanently installed diverse back-up AC power sources (station blackout – SBO)"

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The amount of diesel fuel in the supply tank allows the mobile diesel pump operation for at least 6 hours.

#### **2.2. Comments**

C1. It is not mentioned how to obtain the needed amount of diesel fuel to prolong using of mobile diesel pump up to 72 hours.

#### **2.3. Recommendations**

R1. ....

#### **2.4. References**

"Regulations on stress tests of NPPs"

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	109
Section Number	5.1.3.1
Page	228

Facility	BNPP-2
Issue Title	Battery redundancy, diversity, capacity, duration and possibilities to re-charge batteries

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report states about intention to use 0.2 MW MDG for recharging batteries in case of SBO.

#### **2.2. Comments**

C. Procedure of using 0.2 MW MDG for recharging batteries in case of SBO is not yet available

#### **2.3. Recommendations**

R1. ....

#### **2.4. References**

"Regulations on stress tests of NPPs"

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	110
Section Number	5.2.1.1
Page	238

Facility	BNPP-2
Issue Title	Design provisions to prevent the loss of the primary ultimate heat sink, such as alternative inlets for sea water or systems to protect main water inlet from blocking

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Diesel pump for water supply to SG is purchased by the plan. Report also present information on fire trucks available in the plant's fire brigade. Those could be used for pumping water out of buildings in case of floods, but also for reactor, SG or SFP make-up as last resort measure

#### **2.2. Comments**

C1.Connection point for water supply to SG is not yet defined and procedure is not available.  
C2. Neither connection points between fire trucks and reactor, SG or SFP nor procedures are available to use those

#### **2.3. Recommendations**

R1. ....

#### **2.4. References**

"Regulations on stress tests of NPPs"

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	111
Section Number	5.2.2.2
Page	244

Facility	BNPP-2
Issue Title	Possible time constraints for availability of alternate heat sink and possibilities to increase the available time

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides information on availability of water for SGs during ~ 10 hours.

#### **2.2. Comments**

C. Report does not discuss any measures related to increase availability time of alternate heat sinks for closed primary circuit.

#### **2.3. Recommendations**

R1. ....

#### **2.4. References**

"Regulations on stress tests of NPPs"

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	112
Section Number	5.2.4
Page	245

Facility BNPP-2

Issue Title Conclusion on the adequacy of protection against loss of ultimate heat sink

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report provides information on NPP protection against total loss of UHS.

#### **2.2. Comments**

C. It is not mentioned how to protect fuel from damage in case of loss of ultimate heat sink unless heat removal is ensured via alternate heat sink.

#### **2.3. Recommendations**

R1. ....

#### **2.4. References**

"Regulations on stress tests of NPPs"

## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

	Issue Number	113
	Section Number	5.1.5.2
	Page	234
Facility	BNPP-2	
Issue Title	Measures envisaged to preventing cliff-edge effects and in-creasing robustness of the NPP in case of loss of LOOP and loss of EDGs	

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

Analyses or tests:

The analyses and/or tests listed below were not available at the time this self-assessment:

- identification and analysis of the procedures to be implemented to the EOPs to main-tain the RCP seals integrity (i.e. to prevent RCS temperature increases above 295°C as long as possible) during the long term SBO,
- investigation of credibility of possible leakage paths outside the RCP seals drainage line when RCP seals would be damaged during the long term SBO,
- identification and analysis of the necessity to provide long-term room cooling for the plant equipment (especially power supply distribution systems and I&C) to be used for decay heat removal from the reactor core and SFP,
- identification of measurements to be necessary in the symptom-oriented EOPs to monitor safety functions during the long-term blackout,
- detailed identification of the most proper connections to the current plant systems:
- for the diverse mobile pumps to allow SGs makeup (e.g. flanges at suc-tion and discharge of EFW pumps, etc.),
- for the diverse mobile pumps to allow SFP makeup (e.g. flanges at suc-tion of demineralized water tanks or at suction of ECCS tanks or at com-mon TH70 piping from ECCS tanks, flanges at SFP makeup lines or at ECCS discharge lines, etc.),
- detailed analysis using additional information from the vendor or tests of the 2.0 MW mobile DG to assess its possibility to power:
- EFW pump RS12(22,32,42)D001,
- plant equipment needed to remove heat from the core during cold shut-down (simultaneous power supply for LP ECCS pump, ESW pump and TF system pump in the same EPSS division),
- plant equipment needed to perform feed & bleed strategy in the primary circuit (simultaneous power supply for HP ECCS pump, LP ECCS pump, ESW pump and TF system pump in the same EPSS division),
- test of possibility to power the EFW pump RS12(22,32,42)D001 with 3.1 MW com-mon DG,
- identification and analysis of the optimal strategy to use the 2.0 MW MDG during cold shutdown to provide long-term decay heat removal both from the reactor core and from the SFP during long-term SBO considering:
- the limited power output of MDG, different stages of cold shutdown or re-fuelling,
- available makeup pumps and the necessity to power their support sys-tems,
- available water sources at the plant (in addition to ECCS tanks or gravita-tional drainage of SFP to open reactor) and connections to those sources,



- etc.,
- identification and analysis of the optimal strategy to be implemented in EOPs to pro-long the time available to connect the mobile means (e.g. timing of RCS depressurization to inject HAs, timing of SG depressurization to refill SGs) during long term SBO,
- determination of the proper level of resistance of the alternative and/or mobile means (including their shelters or containers) to the beyond design basis natural hazards,
- analysis of the pressure in the containment during SFP makeup,
- update of probabilistic safety assessment (PSA) for BNPP with all dependencies on the support systems (e.g. dependency of I&C on power supply and room cooling)
- Bushehr NPP Stress Test Self-Assessment Report, revision-1
- and then with agreed SAST measures before their implementation to provide feed-back.

## 2.2. Comments

- C1: The above-mentioned should be evaluated on the final stress test results reports

## 2.3. Recommendations

R1. ....

## 2.4. References

(References which are used for the comments and recommendations)

## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

	Issue Number	114
	Section Number	5.1.5.3
	Page	237
Facility	BNPP-2	
Issue Title	Measures envisaged to preventing cliff-edge effects and increasing robustness of the NPP in case of station blackout without recovery of AC power	

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

Analyses or tests •

- The analyses and/or tests listed below were not available at the time this self-assessment:
- identification and analysis of procedures to be implemented in EOPs to assure sufficient amount of water to feed SGs for at least 72 hours (e.g. depressurization of SGs to allow smaller FW flowrate, etc.),
- detailed identification of the most proper connections to the current plant systems:
- for the diverse mobile pumps to allow makeup of the open reactor (e.g. flanges at suction of ECCS tanks or at common TH70 piping from ECCS tanks, flanges at ECCS discharge lines or at RCS makeup lines, etc.),
- identification and analysis of the procedures to be implemented in the EOPs to maintain the sufficient margin to secondary criticality during cooldown or depressurization,
- identification and test of the procedures to be implemented in the EOPs to prolong the time to the accumulator batteries depletion (e.g. load shedding, cross-connection of divisions, etc.),
- analysis of the pressure in the containment during makeup of the open reactor.
- 

#### 2.2. Comments

C1: The above-mentioned should be evaluated on the final stress test results

#### 2.3. Recommendations

R1. ....

#### 2.4. References

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	115
Section Number	5.2.2.1
Page	241

Facility BNPP-2

Issue Title Table 5-3 Allowed temperatures for electrical and I&C systems

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Allowed temperatures for electrical and I&C systems in accident conditions for  
Process equipment compartment considered up to 75°C

#### **2.2. Comments**

C1: High temperature effects on the reliability analysis of the control systems .It should be explained about the process safety data for nuclear control systems.

#### **2.3. Recommendations**

R1. ....

#### **2.4. References**

(References which are used for the comments and recommendations)

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	116
	Section Number	5.2.5.1
	Page	248
Facility	BNPP-2	
Issue Title	Measures envisaged to preventing cliff-edge effects and increasing robustness of the NPP in case of loss of the primary UHS	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Analyses or tests •

- identification and analysis of the necessity to provide long-term room cooling for the plant equipment (especially power supply distribution systems and I&C) to be used for decay heat removal from the reactor core and SFP,
- identification of measurements to be necessary in the symptom-oriented EOPs to monitor safety functions during loss of the primary UHS,
- identification and analysis of procedures to be implemented into EOPs to assure sufficient amount of water to feed SGs for at least 72 hours (e.g. depressurization of SGs to allow smaller FW flowrate, etc.),
- Bushehr NPP Stress Test Self-Assessment Report, revision-1 Page 249 of 364
- evaluation of a possibility to provide long term makeup from the tanks to the open re-actor or SFP at least for 72 hours with HP ECCS, LP ECCS, SFP cooling pump or pumps TA31,32,33D001 without heat removal from the associated system TF to ESW,
- analysis of the pressure in the containment during makeup of SFP,
- determination of the proper level of resistance of alternative and/or mobile means (including their shelters or containers) to beyond design basis natural hazards,
- update of probabilistic safety assessment (PSA) for BNPP with modelling all dependencies on the support systems (e.g. dependency of I&C on power supply and room cooling) and then with agreed SAST measures before their implementation to provide feedback.

#### **2.2. Comments**

C1: The above-mentioned should be evaluated on the final stress test results

#### **2.3. Recommendations**

R1. ....

#### **2.4. References**

R1. ....

#### 2.4. References

(References which are used for the comments and recommendations)

## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

	3	117
	Section Number	5.3.3
	Page	255
Facility	BNPP-2	
Issue Title	Measures envisaged preventing cliff-edge effects and in-creasing robustness of the NPP in case of loss of primary ul-timate heat sink, combined with station black out	

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

Analyses or tests •

- to prevent LOCA via RCP seals (including isolation of RCP seals drainage lines),
- to isolate possible leakage paths from RCS (including isolation of RCS blowdown lines),
- to use the internal plant pumps independent on the primary UHS, or ca-pable of long-term function without heat removal to the primary UHS, for a long-term emergency makeup of the open reactor,
- to use the internal plant pumps, which are possible to be powered from 2.0 MW MDG in addition to the pump providing reactor core cooling and which are independent on the primary UHS, for a long-term emergency makeup of SFP,
- to use ECCS pumps to refill the refuelling pool, if possible, e.g. to prolong the time window available for diesel pump connection,
- to depressurize SGs to allow the eventual use of the fire brigade pumps for SGs makeup and to allow smaller FW flowrate to SGs,
- to maintain the sufficient margin to secondary criticality during cooldown or depressurization,
- to depressurize the containment during makeup of the open reactor or SFP,
- to use the common DG to power the pump TH71D001 to make up the open reactor or SFP,
- to prolong the time to the accumulator batteries depletion,
- Bushehr NPP Stress Test Self-Assessment Report, revision-1
- consideration of reduction of mid-loop operation as well as consideration of restrictive conditions for such operation (e.g. specification of requirements for system availabili-ties, etc.),
- implementation of procedures for local manipulations with the alternative and/or mo-bile means, including (but not limited to) procedures:
  - to prepare and connect the mobile means,
  - to open valves inside the unit during blackout,
  - to assure sufficient amount of fuel for the alternative or mobile means to run for at least 72 hours,
  - to assure sufficient amount of water for the mobile diesel pumps to feed SGs and to make up SFP for at least 72 hours,
  - to monitor the plant parameters using portable devices,
  - providing the sufficient staff and implementation of training process to use the alter-native and/or mobile means,
  - providing testing and assuring availability of the alternative and/or mobile means (in-cluding access to them during hazards),
  - consideration of training process to use the common DG to power the safety systems in case of blackout.

- Analyses or tests:
- These analyses and/or tests were not available at the time when this self-assessment was performed.
- identification and analysis of the procedures to be implemented in EOPs to maintain RCP seals integrity (i.e. to prevent RCS temperature increases above 295°C as long as possible) during long term SBO,
- investigation of credibility of the possible leakage paths outside the RCP seals drain-age line when RCP seals would be damaged during long term SBO,
- identification and analysis of the necessity to provide long-term room cooling for the plant equipment (especially power supply distribution systems and I&C) to be used for decay heat removal from the reactor core and SFP,
- identification of measurements to be necessary in the symptom-oriented EOPs to monitor safety functions during long-term SBO and loss of the primary UHS,
- detailed identification of the most proper connections to the current plant systems:
- for the diverse mobile pumps to allow SGs makeup (e.g. flanges at suction and discharge of EFW pumps, etc.),
- for the diverse mobile pumps to allow makeup of the open reactor (e.g. flanges at suction of ECCS tanks or at common TH70 piping from ECCS tanks, flanges at ECCS discharge lines or at RCS makeup lines, etc.),
- for the diverse mobile pumps to allow SFP makeup (e.g. flanges at suction of the demineralized water tanks or at suction of ECCS tanks or at common TH70 piping from ECCS tanks, flanges at SFP makeup lines or at ECCS discharge lines, etc.),
- detailed analysis using additional information from the vendor or tests of 2.0 MW mobile DG to assess its possibility to power EFW pump RS12(22,32,42)D001,
- Bushehr NPP Stress Test Self-Assessment Report, revision-1
- test of possibility to power EFW pump RS12(22,32,42)D001 with 3.1 MW common DG,
- identification and analysis of the optimal strategy to use 2.0 MW MDG during cold shutdown to provide long-term decay heat removal both from the reactor core and from SFP during long-term SBO combined with loss of the primary UHS considering:
- the limited power output of MDG,
- different stages of cold shutdown or refuelling,
- available makeup pumps and dependency of their cooling on the primary UHS,
- available water sources at the plant (in addition to ECCS tanks or gravitational drainage of SFP to the open reactor) and connections to those sources,
- analysis of a possibility to provide long term makeup from the tanks to the open reactor or SFP at least for 72 hours with HP ECCS, LP ECCS, SFP cooling pump or pumps TA31,32,33D001 without heat removal from the associated system TF to ESW and without possibility to makeup the system TF,
- identification and analysis of the procedures to be implemented in EOPs to assure sufficient amount of water to feed SGs for at least 72 hours (e.g. depressurization of SGs to allow smaller FW flowrate, etc.),
- identification and analysis of the optimal strategy to be implemented in EOPs to prolong the time available to connect the mobile means (e.g. timing of RCS depressurization to inject HAs, timing of SG depressurization to refill SGs) during long term SBO,
- identification and test of procedures to be implemented in EOPs to prolong the time to the accumulator batteries depletion as much as feasible (e.g. load shedding, cross-connection of divisions, etc.),

- determination of the proper level of resistance of the alternative and/or mobile means (including their shelters or containers) to beyond design basis natural hazards,
- identification and analysis of procedures to be implemented in EOPs to maintain the sufficient margin to secondary criticality during cooldown or depressurization,
- analysis of the pressure in the containment during makeup of SFP and the open re-actor,
- update of probabilistic safety assessment (PSA) for BNPP with modelling of all de-pendencies on the support systems (e.g. dependency of I&C on power supply and room cooling) and then

## 2.2. Comments

- C1: The above-mentioned should be evaluated on the final stress test results

## 2.3. Recommendations

R1. ....

## 2.4. References

(References which are used for the comments and recommendations)



### 2.3.6 Detail Comments on Section 6

ISSUE SHEET		
<b>1. ISSUE IDENTIFICATION</b>	Issue Number	118
	Section Number	6.1.1.1
	Page	260
Facility	BNPP-1	
Issue Title	Staffing and shift management in normal operation-1	
<b>2. ISSUE CLARIFICATION</b>		
<u>2.1. Issue Description</u>		
<p>Reports provides comprehensive and well balanced information on staffing and shift management, covering, both normal operation and accidents. The report in comprehensive manner present BNPP-1 accident management arrangements, organizational structure and communication scheme. However, organizational structure and communication scheme figures include number of abbreviations that are not listed in the “ABBREVIATION” table of the document.</p>		
<u>2.2. Comments</u>		
<p>C1.the list of abbreviations should updated respectively.</p>		
<u>2.3. Recommendations</u>		
<p>R1.</p>		
<u>2.4. References</u>		
<p>-----</p>		

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	119
Section Number	6.1.1.1
Page	260

Facility	BNPP-1
Issue Title	Staffing and shift management in normal operation-2

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report provides comprehensive information on BNPP- 1 organizational structure, composition of the shift and number of shift operation personnel, covering also number of emergency staff presented in case of accident in MCR and plant management duties to announce Site Area Emergency» or «General Emergency» and defines timing for emergency actions and notifications.

However, the report does not provide details who are assigned with duties to support MCR operators during accidents (emergency staff) and what are their functions and responsibilities.

#### **2.2. Comments**

C1. The personnel who support MCR operators during accidents (emergency staff) and their functions and responsibilities should be presented.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	120
Section Number	6.1.1.1
Page	260

Facility	BNPP-1
Issue Title	Staffing and shift management in normal operation-3

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Information on staffing of operational personnel is clear and comprehensive. While report mentions external emergency support personnel and refers to emergency procedures and plans it does not include details on emergency support arrangements – i.e. composition, number of persons, duties, areas of responsibilities etc.

#### **2.2. Comments**

C1. The composition, number of persons, duties and areas of responsibilities should be clarified in emergency support personnel procedure.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	121
Section Number	6.1.1.2
Page	265

Facility	BNPP-1
Issue Title	Measures taken to enable optimum intervention by personnel

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report provides an overview of measures intended to enable optimal intervention by personnel carried out according to emergency operating procedures and guidelines for beyond design basic accidents for BNPP – 1 that are in place, however both procedures and guidelines are event oriented and SAMGs are so far not available. The report lacks information when ongoing development of SAMGs will be completed and when those will be put in place.

#### **2.2. Comments**

C1. SAMGs should be presented as soon as possible.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	122
	Section Number	6.1.1.3
	Page	267
Facility	BNPP-1	
Issue Title	Use of off-site technical support for accident management	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report includes full details on use of off-site technical support for accident management as well as lists formal procedures used for coordination of activities; however report refers only to BNPP-1 EP&R procedures, while formal procedures are also required for all local authorities and organizations. It is not clear from the report whether BNPP EP&R plan covers also those organizations.

Reference [7] – “Personnel protection activity plan in case of accident at Bushehr-1 NPP” deals with threat to NPP personnel, but report lacks information which procedures cover other authorities.

#### **2.2. Comments**

C1. The formal procedure to cover all local authorities and organizations should be in place.  
C2. Does the BNPP EPR plan covers these organizations?

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	123
Section Number	6.1.1.3
Page	267

Facility	BNPP-1
Issue Title	Use of off-site technical support for accident management-2

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report lists duties of the state and includes organizational scheme of the local emergency response groups and organizational scheme of the offsite radiological protection, however report lacks information which formal procedures define those and whether and how often such arrangements are exercised/ tested.

#### **2.2. Comments**

C1. The report of exercise or test of mentioned procedures should be addressed.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	124
Section Number	6.1.1.3
Page	267

Facility	BNPP-1
Issue Title	Use of off-site technical support for accident management-3

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides information on protection management.

#### **2.2. Comments**

C1. There are lacks information on possible contingencies – e.g. support to EP&R at corporate level, state level that should be also defined via formal procedures.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	125
	Section Number	6.1.1.4
	Page	269
Facility	BNPP-1	
Issue Title	Procedures, training and exercises-1	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report provides information regarding accident management procedures however it has more focus on emergency OPERATIONAL procedures – i.e. reactor, turbine, electric installations etc. and very little detail related to EP&R.

#### **2.2. Comments**

C1. Focus of this section should be shifted more to EP&R.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	126
Section Number	6.1.1.4
Page	269

Facility	BNPP-1
Issue Title	Procedures, training and exercises-2

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides information on accident management training for BNPP shift personnel however lacks information on training of other staff and BNPP external partners that will be involved in Off-site Emergency Plan.

#### **2.2. Comments**

C1. Information on training of other staff and BNPP external partners that should be involved in Off-site Emergency Plan and addressed as well.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	127
Section Number	6.1.1.4
Page	269

Facility	BNPP-1
Issue Title	Procedures, training and exercises-3

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides information regarding accident management exercises of BNPP operational staff, but lacks in information for other and external organisations personnel. Report does not provided any information whether those were ever conducted and whether scope and periodicity of those are defined.

#### **2.2. Comments**

C1. Information for other and external organisations personnel should be provided.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	128
Section Number	6.1.2.1
Page	273

Facility	BNPP-1
Issue Title	Provisions to use mobile devices-1

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report includes very limited information on the possibility to use existing equipment. Table 6-1 lists water inventory, but use of equipment and systems, especially availability and possibility of using those in case of LOOP/SBO is not described.

#### **2.2. Comments**

C1. Use of equipment and systems, especially availability and possibility of using those in case of LOOP/SBO should be described.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	129
Section Number	6.1.2.1
Page	273

Facility	BNPP-1
Issue Title	Provisions to use mobile devices-2

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report provides information regarding the mobile devices already available at BNPP and also planned to be purchased, however currently neither connection points, nor procedures are developed even for equipment already available on-site. Time-frame for purchase of additional equipment is also not defined.

#### **2.2. Comments**

C1. Connection points and procedures should developed and addressed as well.  
C2. Time-frame for purchase of additional equipment should be clearly defined.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	130
Section Number	6.1.2.1
Page	273

Facility	BNPP-1
Issue Title	Provisions to use mobile devices-3

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report contains information on assumed time (~ 10 min) needed to bring the mobile devices at place on site, but this needs to be confirmed during real exercises. Reports also makes some reservations that “Non-availability of the trailers or debris accumulation on the transfer routes could influence this time estimate.” It is believed that mobile equipment shall have own trailers, so the reason for this reservation is not clear.

#### **2.2. Comments**

- C1. The results of real exercises for bring the mobile devices at place on site should be presented in the report.
- C2. The reason for the mentioned reservation should be described.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	131
Section Number	6.1.2.1
Page	274

Facility	BNPP-1
Issue Title	Provisions to use mobile devices-4

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report does not contain information on time needed to deploy mobile devices once available on site. This needs to be checked during real exercises; however the report does not define any time-frames when this could be achieved.

#### **2.2. Comments**

C1. The time frame for mobile devices availability on the site and the results of real exercise should be presented.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	132
Section Number	6.1.2.2
Page	274

Facility	BNPP-1
Issue Title	Provisions for and management of supplies-1

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report contains detailed information regarding the current provision for supplies, including inventories of demineralized borated and drinking water and diesel fuel, however, as report notes, corresponding procedures for use of these with mobile equipment need to be developed and included in the training. The mobile pumps could also use sea water as the coolant; however corresponding procedures have to be also developed.

#### **2.2. Comments**

C1. The above mentioned procedures should be presented/addressed.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	133
Section Number	6.1.2.2
Page	274

Facility	BNPP-1
Issue Title	Provisions for and management of supplies-2

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report includes information on current arrangements on management of supplies, however procedures for delivery of fuel to the DGs day fuel tanks still need to be developed and included in the training and drills, however timeframe for the development is not defined.

It should be also noted that BNPP plans to purchase other mobile equipment – e.g. for primary circuit, SFP etc., so the plant should define consumption of fuel by additional equipment and evaluate how much fuel is necessary for operation of all DGs and mobile equipment for at least 72 hours. Report establishes timeframe for evaluation as Short Term measure.

#### **2.2. Comments**

C1. There is no procedures for delivery of fuel to the DGs day fuel tanks.  
C2. consumption of fuel by additional equipment and evaluation how much fuel is necessary for operation of all DGs and mobile equipment for at least 72 hours should be presented.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	134
Section Number	6.1.2.3
Page	279

Facility BNPP-1

Issue Title Management of radioactive releases and provisions to limit them

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report contains information on provisions to limit radioactive releases, however in some cases additional analyses are necessary – e.g. rated capacity of hydrogen recombiners to cope with BDBA, containment venting , introduction of EOPs and SAMGs etc.

#### **2.2. Comments**

C1. Additional analyses for some case such as rated capacity of hydrogen recombiners to cope with BDBA, containment venting , introduction of EOPs and SAMGs should be presented.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	135
Section Number	6.1.2.4
Page	279

Facility	BNPP-1
Issue Title	Communication and information systems (internal and external)-1

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides detailed information on plant communication systems and states that “Communication systems for accident management are placed at ZV.1 building, powered from a dedicated DG”, but “So far, no operating instruction has been developed for implementation of this DG in emergency conditions.”

It is not clear from the report whether ALL communication systems are powered from this DG. Report does not state that communication systems are powered from the I category power supply source, so if that is the case then in case of plant SBO there will be delay in communication between operational personnel; content of section 6.1.2.4 should be checked and updated if required.

#### **2.2. Comments**

- C1. It is not clear from the report whether all communication systems are powered from this DG?
- C2. The delay in communication between operational personnel be checked and updated.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

	Issue Number	136
	Section Number	6.1.2.4
	Page	279
Facility	BNPP-1	
Issue Title	Communication and information systems (internal and external)-2	

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

While report mentioned in general communication with external bodies in case of nuclear accident this section of the report is focused on internal communication only and does not provide details on external communication arrangements.

#### 2.2. Comments

C1. There is no details on external communication arrangements.

#### 2.3. Recommendations

R1.

#### 2.4. References

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	137
Section Number	6.1.3.1
Page	280

Facility	BNPP-1
Issue Title	Extensive destruction of infrastructure or flooding around the installation that hinders access to the site

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report did not provide any information regarding other identified means that could hinder access to the site.

#### **2.2. Comments**

C1. There is no information regarding other identified means that would hinder access to the site.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	138
Section Number	6.1.3.2
Page	281

Facility	BNPP-1
Issue Title	Loss of communication facilities/ systems

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides statement that there is a possibility to loss communication system, however operation of those was not assessed with respect of their seismic resistance and autonomy of work.

The report, however foresee backup solution to use communication equipment provided by military, fire brigade, but does not reflect any info whether such agreements were discussed and reached.

#### **2.2. Comments**

C1. There is no assessment about operation of communication system with respect of their seismic resistance and autonomy of work.

C2. Agreements by military and fire brigade should be addressed.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	139
Section Number	6.1.3.3
Page	279

Facility	BNPP-1
Issue Title	Impairment of work performance due to high local dose rates, radioactive contamination and destruction of some facilities on site-1

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report does not provide specific information on high local dose rates on site or in some areas during the accident, but recommends doing respective analysis.

#### **2.2. Comments**

C1. There is no specific information on high local dose rates on site or in some areas during the accident.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	140
Section Number	6.1.3.3
Page	279

Facility	BNPP-1
Issue Title	Impairment of work performance due to high local dose rates, radioactive contamination and destruction of some facilities on site-2

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report does not provide specific information on potential of radioactive contamination on site during the accident, but recommends carrying out respective analysis. Implementation is defined as Medium Term measure.

#### **2.2. Comments**

C1. There is no specific information on potential of radioactive contamination on site during the accident.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	141
Section Number	6.1.3.3
Page	279

Facility	BNPP-1
Issue Title	Impairment of work performance due to high local dose rates, radioactive contamination and destruction of some facilities on site-3

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report does not provide specific information on potential destruction of some facilities on site during the accident, but recommends doing respective analysis.

#### **2.2. Comments**

C1. There is no specific information on potential destruction of some facilities on site during the accident

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	142
Section Number	6.1.3.3
Page	279

Facility	BNPP-1
Issue Title	Impairment of work performance due to high local dose rates, radioactive contamination and destruction of some facilities on site-4

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report does not provide specific information on potential impairment (due to doses and/ or destructions) of work performance of emergency response staff, but recommends doing respective analysis.

#### **2.2. Comments**

C1. There is no specific information on potential impairment of work performance of emergency response staff.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	143
Section Number	6.1.3.4
Page	282

Facility BNPP-1

Issue Title

Impact on the accessibility and habitability of the main and secondary control rooms, measures to be taken to avoid or manage this situation-1

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides information regarding measures that would mitigate the conditions preventing staff from working in the main or secondary control room during the accidents, however such an analysis was not done for BDBA. Timeframe for performing such an analysis is also not defined.

Report states that “overpressure in the control rooms is maintained by air supply from the compressed air cylinders” and in other part it states “Air supply of 100 m<sup>3</sup>/min to MCR/ECR rooms provides overpressure at least 20 Pa sufficient to prevent intake of the dangerous substances”; it is doubtful that air cylinders could provide 100 m<sup>3</sup>/min, also flow value for overpressurization of MCR/ECR seems too high.

#### **2.2. Comments**

C1. The above mentioned analysis should be done for BDBA and the results should be addressed as well.

C2. Justification for air cylinders flowrate should be presented.

C3. Justification for flow value for overpressurization of MCR/ECR should be presented.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	144
Section Number	6.1.3.5
Page	282

Facility	BNPP-1
Issue Title	Impact on the different premises used by the crisis teams or for which access would be necessary for management of the accident-2

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides information on all premises that are to be used by crisis teams for management of the accident, but report also recommends to perform the analysis of the expected radiological situation on the site under conditions of a severe accident and to evaluate the robustness of the given premises against the external hazards. Implementation is defined as Medium Term measure.

#### **2.2. Comments**

C1. The analysis of the expected radiological situation on the site under conditions of a severe accident and evaluation of the robustness of the given premises against the external hazards should be presented.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

Issue Number	145
Section Number	6.1.3.6
Page	284

Facility	BNPP-1
Issue Title	Feasibility and effectiveness of accident management measures under the conditions of external hazards (earthquakes, floods)-1

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

Report provides information regarding the potential site conditions evoked by external hazards in question that could impair accident management measures, report also recommends to evaluate flood resistance of the Standby Crisis Centre (SCC) located in the basement of the ZV1 building, but time frame for this is not defined.

#### 2.2. Comments

C1. Evaluation of flood resistance of SCC should present in the report.

#### 2.3. Recommendations

R1.

#### 2.4. References

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	146
Section Number	6.1.3.6
Page	284

Facility	BNPP-1
Issue Title	Feasibility and effectiveness of accident management measures under the conditions of external hazards (earthquakes, floods)-2

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Considering robustness of the MCR/ECR and other crisis centers, except SCC, is ensured against seismic and flood events accident management in case of external hazards like earthquakes and floods could be considered as feasible and efficient. Considering that flood resistance of SCC located in the basement of the ZV1 building is questionable and therefore needs to be evaluated in further detail; however timeframe for this evaluation is not defined; it is also not listed among potential safety improvements. This evaluation is also important from communication point of view as SCC is designated to accommodate plant management and ensure permanent communication with the authorities of Bushehr city, Government authorities, operating organization and INRA/NNSD.

#### **2.2. Comments**

C1. Flood resistance of SCC should be evaluated in further detail.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	147
	Section Number	6.1.3.7
	Page	285
Facility	BNPP-1	
Issue Title	Unavailability of power supply	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides detailed information regarding potential site conditions evoked by external hazards in question that could result in unavailability of power supply. Report clearly defines arrangement in case of LOOP and SBO. Considering redundancy and availability of additional stationary DGs and mobile DGs management of accidents with this additional equipment could be considered as feasible and efficient. However connection points and operational procedures for use of additional non-safety systems and mobile DGs are not yet developed/defined. Implementation is defined as Short Term measure.

It should be also noted that not all these additional DGs could be credited for operation in seismic conditions as neither diesels themselves, nor buildings where these are located are seismically qualified.

#### **2.2. Comments**

C1. Connection points and operational procedures for use of additional non-safety systems and mobile DGs should be developed/defined.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	148
Section Number	6.1.3.8
Page	285

Facility	BNPP-1
Issue Title	Potential failure of instrumentation

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report does not provide information on potential failure and assessment of potential instrumentation failure on feasibility and effectiveness of accident management. Report states that current list of parameters, monitoring ranges qualification, availability of the batteries to supply instrumentation or use of additional autonomous means for measurement of important plant parameters will be reassessed after finalization of the SAMGs; Implementation is defined as Medium Term measure.

#### **2.2. Comments**

C1. There is no information on potential failure and assessment of potential instrumentation failure on feasibility and effectiveness of accident management.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	149
Section Number	6.1.4
Page	285

Facility	BNPP-1
Issue Title	Conclusion on the adequacy of organisational issues for accident management

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report does not provide information on acceptance criteria for emergency response organization.

#### **2.2. Comments**

C1. There is no information on acceptance criteria for emergency response organization.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	150
Section Number	6.1.5
Page	287

Facility	BNPP-1
Issue Title	Measures envisaged enhancing accident management capabilities-1

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report does not provide specific information on high local dose rates on site or in some areas during the accident, but recommends doing respective analysis. Report provides information on all premises that are to be used by crisis teams for management of the accident, but report also recommends to perform the analysis of the expected radiological situation on the site under conditions of a severe accident and to evaluate the robustness of the given premises against the external hazards; Implementation is defined as Medium Term measure.

#### **2.2. Comments**

C1. There is no specific information on high local dose rates on site or in some areas during the accident.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	151
Section Number	6.1.5
Page	287

Facility	BNPP-1
Issue Title	Measures envisaged enhancing accident management capabilities-2

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report does not provide specific information on potential of radioactive contamination on site during the accident, but recommends doing respective analysis. Implementation is defined as Medium Term measure.

#### **2.2. Comments**

C1. There is no specific information on potential of radioactive contamination on site during the accident

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	152
Section Number	6.1.5
Page	287

Facility	BNPP-1
Issue Title	Measures envisaged enhancing accident management capabilities-3

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Considering robustness of the MCR/ECR and other crisis centers, except SCC, is ensured against seismic and flood events accident management in case of external hazards like earthquakes and floods could be considered as feasible and efficient. However considering that flood resistance of SCC located in the basement of the ZV1 building is questionable and therefore needs to be evaluated in further detail; however timeframe for this evaluation is not defined; it is also not listed among potential safety improvements. This evaluation is also important from communication point of view as SCC is designated to accommodate plant management and ensure permanent communication with the authorities of Bushehr city, government authorities, operating organization and INRA/NNSD.

#### **2.2. Comments**

C1. There is no flood resistance of SCC located in the basement of the ZV1 building.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	153
Section Number	6.1.5
Page	287

Facility	BNPP-1
Issue Title	Measures envisaged enhancing accident management capabilities-4

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides detailed information regarding potential site conditions evoked by external hazards in question that could result in unavailability of power supply. Report clearly defines arrangement in case of LOOP and SBO. Considering redundancy and availability of additional stationary DGs and mobile DGs management of accidents with this additional equipment could be considered as feasible and efficient. However connection points and operational procedure for use of additional non-safety systems and mobile DGs are not yet developed. Implementation is defined as Short Term measure. It should be also noted that not all these additional DGs could be credited for operation in seismic conditions as neither diesels themselves, nor buildings where these are located are seismically qualified.

Report states that attention needs to be paid to robustness of DC power against extreme external hazards further enhanced by a possibility to recharge the batteries.

Implementation is defined as Short Term measure.

#### **2.2. Comments**

C1. Connection points and operational procedure for use of additional non-safety systems and mobile DGs should be developed and addressed as well.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	154
Section Number	6.1.5
Page	287

Facility	BNPP-1
Issue Title	Measures envisaged enhancing accident management capabilities-5

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report does not provide information on potential failure and assessment of potential instrumentation failure on feasibility and effectiveness of accident management. Report states that current list of parameters, monitoring ranges, availability of the batteries to supply instrumentation or use of additional autonomous means for measurement of important plant parameters will be reassessed after finalization of the SAMGs; Implementation is defined as Medium Term measure.

#### **2.2. Comments**

C1. There is no potential failure and assessment of potential instrumentation failure on feasibility and effectiveness of accident management.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	155
Section Number	6.1.5
Page	288

Facility	BNPP-1
Issue Title	Measures envisaged enhancing accident management capabilities-6

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Considering location of the facilities in 30 km area (mainly food production) and the fact that those that might have impact (military) are rather remote events at neighbouring facilities were screened out in the report.

#### **2.2. Comments**

C1. There is no any measures which can be envisaged to enhance accident management capabilities taking into account potential effects from other neighbouring plants at site.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	156
Section Number	6.2.1
Page	291

Facility	BNPP-1
Issue Title	Description of AM measures aimed at preventing fuel damage in the reactor pressure vessel-1

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report provides information on last resort measures to be implemented to prevent fuel damage; however those do not consider mobile equipment. Considering that SAMGs development is ongoing this issue should be looked at once again SAMGs are finalized.

#### **2.2. Comments**

C1. The report provides information on last resort measures to be implemented to prevent fuel damage; however those do not consider mobile equipment.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	157
Section Number	6.2.2
Page	291

Facility	BNPP-1
Issue Title	Description of AM measures after fuel damage in the reactor pressure vessel-2

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The reports describes the approach of using the existing plant systems and corresponding accident management actions for core cooling in case of core melting as described in the BDBA manual. The report does not reflect use of mobile equipment, as neither connection points, nor procedures are established; Implementation is defined as Short Term measure. This issue should be also addressed in SAMGs that are being developed; Implementation is defined as Medium Term measure.

#### **2.2. Comments**

C1. Use of mobile equipment are not established in the report. It should be done.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	158
Section Number	6.2.3
Page	291

Facility	BNPP-1
Issue Title	Description of AM measures after failure of the reactor pressure vessel-3

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report does not provide such an information as currently ex-vessel phase of severe accident is not addressed neither by the BDBA manual, nor by any other accident procedures or guidelines. The report does not reflect use of mobile equipment, as neither connection points, nor procedures are established. This issue should be addressed in SAMGs that are being developed; Implementation is defined as Medium Term measure.

#### **2.2. Comments**

C1. There is no information regarding the accident management measures to be implemented after failure of the reactor.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	159
Section Number	6.2.4
Page	293

Facility	BNPP-1
Issue Title	Measures envisaged enhancing the core cooling function

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report refers to generally adopted approach using all available safety and non-safety systems and proposes installation of new hardware that will increase the probability of the success of the strategies of core cooling. Report recommends carrying out feasibility study of heat transfer to UHS; Implementation is defined as Medium Term measure. The report does not reflect use of mobile equipment, as neither connection points, nor procedures are established. This issue should be addressed in SAMGs that are being developed, Implementation is defined as Medium Term measure.

#### **2.2. Comments**

C1. feasibility study of heat transfer to UHS should be carryout and the results should be addressed.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	160
Section Number	6.3.1.1
Page	293

Facility	BNPP-1
Issue Title	Design provisions preventing fuel damage/ meltdown in high pressure-1

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report refers to generally adopted approach using all available safety and non-safety systems and proposes installation of new hardware that will increase the probability of the success of the strategies of core cooling. Report recommends carrying out feasibility study for implementing additional modernisation. Development of plan for such modernisations is defined as Short Term measure.

The report does not reflect use of mobile equipment, as neither connection points, nor procedures are established; Implementation is defined as Short Term measure.

This issue should be addressed in SAMGs that are being developed, Implementation is defined as Medium Term measure.

#### **2.2. Comments**

C1. Feasibility study for implementing additional modernization should be done.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	161
Section Number	6.3.1.1
Page	293

Facility	BNPP-1
Issue Title	Design provisions preventing fuel damage/ meltdown in high pressure-2

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides information regarding measures that would mitigate the conditions preventing staff from working in the main or secondary control room during the accident, however such an analysis was not done for BDBA. Timeframe for performing such an analysis is defined as Medium Term measure.

#### **2.2. Comments**

C1. The above mentioned analysis should be done and addressed as well.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	162
Section Number	6.3.1.1
Page	293

Facility	BNPP-1
Issue Title	Design provisions preventing fuel damage/ meltdown in high pressure-3

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report did not consider potential hydrogen accumulations in other buildings than containment taken into account in cliff-edge effect analyses, however the report looked at risk of potential hydrogen explosions during containment venting. Report proposed to used plant design ventilation lines (TL09) for containment venting and implementing adequate measures to ensure robustness of venting lines possibly with their inerting; Implementation is defined as Long Term measure.

#### **2.2. Comments**

C1. There is no analysis about potential hydrogen accumulations in other buildings than containment taken into account in cliff-edge effect.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

Issue Number	163
Section Number	6.3.1.2
Page	295

Facility	BNPP-1
Issue Title	Operational provisions preventing fuel damage/ meltdown in high pressure-1

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

Report provides description of operational provisions foreseen for accident management measures. This includes depressurisation of primary circuit followed by use of first and secondary stage hydroaccumulators. Report states that issue of depressurization of the primary circuit will be comprehensively addressed in the new symptom-based SAMGs; Implementation is defined as Medium Term measure.

#### 2.2. Comments

C1. There is no information about depressurization of the primary circuit.

#### 2.3. Recommendations

R1.

#### 2.4. References

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## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

Issue Number	164
Section Number	6.3.1.2
Page	295

Facility	BNPP-1
Issue Title	Operational provisions preventing fuel damage/ meltdown in high pressure-2

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

Report did not identified of cliff-edge effects resulting from current operational provisions, but has clear focus on design provisions; Report, however indicates necessity of implementation of the SAMGs and symptom-oriented EOPs for all plant and SFP operating modes. Implementation is defined as Medium Term measure.

#### 2.2. Comments

C1. Cliff-edge effects resulting from current operational provisions should be identified.

#### 2.3. Recommendations

R1.

#### 2.4. References

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## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

Issue Number	165
Section Number	6.3.1.2
Page	295

Facility	BNPP-1
Issue Title	Operational provisions preventing fuel damage/ meltdown in high pressure-3

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

Report did not evaluate time before cliff-edge effects resulting from current operational provisions; however the report indicates necessity implementation of the SAMGs and symptom-oriented EOPs for all plant and SFP operating modes. Implementation is defined as Medium Term measure.

#### 2.2. Comments

C1. Time before cliff-edge effects resulting from current operational provisions should be evaluated.

#### 2.3. Recommendations

R1.

#### 2.4. References

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	166
Section Number	6.3.1.2
Page	295

Facility	BNPP-1
Issue Title	Operational provisions preventing fuel damage/ meltdown in high pressure-4

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report indicates that instrumentation could be lost due to long-term unavailability of ventilation. Detailed instructions how to cope with such cases are to be detailed in EOPs and SAMGs being developed. Implementation is defined as Medium Term measure.

#### **2.2. Comments**

C1. Detailed instructions how to cope with loss of instrumentations due to long-term unavailability of ventilation should be developed.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

Issue Number	167
Section Number	6.3.1.2
Page	295

Facility	BNPP-1
Issue Title	Operational provisions preventing fuel damage/ meltdown in high pressure-5

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

Report provides information regarding measures that would mitigate the conditions preventing staff from working in the main or secondary control room during the accident, however such an analysis was not done for BDBA. Implementation is defined as Medium Term measure.

#### 2.2. Comments

C1. The analysis of measures that would mitigate the conditions preventing staff from working in the main or secondary control room during the accident should be done.

#### 2.3. Recommendations

R1.

#### 2.4. References

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	168
	Section Number	6.3.1.2
	Page	295
Facility	BNPP-1	
Issue Title	Operational provisions preventing fuel damage/ meltdown in high pressure-6	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report did not consider potential hydrogen accumulations in other buildings than containment taken into account in cliff-edge effect analyses, however the report looked at risk of potential hydrogen explosions during containment venting. Report proposed to used plant design ventilation lines (TL09) for containment venting and implementing adequate measures to ensure robustness of venting lines possibly with their inerting; Implementation is defined as Long Term measure.

#### **2.2. Comments**

C1. Potential hydrogen accumulations in other buildings than containment should be taken into account in cliff-edge effect analyses.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	169
Section Number	6.3.2.1
Page	297

Facility	BNPP-1
Issue Title	Design provisions, including consideration of adequacy in view of hydrogen production rate and amount-1

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report provides detailed information on current design provisions for preventing hydrogen deflagration or detonation; however design capacity of the system is sufficient for coping with design basis accidents only.

#### **2.2. Comments**

C1. Design provisions for preventing hydrogen deflagration or detonation should be presented in detail.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	170
	Section Number	6.3.2.1
	Page	297
Facility	BNPP-1	
Issue Title	Design provisions, including consideration of adequacy in view of hydrogen production rate and amount-2	

### **2. ISSUE CLARIFICATION**

#### 2.1. Issue Description

Report clearly states that current configuration of PARs is not sufficient to successfully cope with all BDBA. To prevent potential hydrogen issue in case of BDBA report recommends increasing capacity of the hydrogen recombiners, extending range of hydrogen concentration monitor; Implementation is defined as Short Term measure; while assessment could be implemented in short term, modernisation of system themselves is likely to be treated as Long Term measure; and developing clear instructions in SAMGs; Implementation is defined as Medium Term measure.

#### 2.2. Comments

C1. Capacity of the hydrogen recombiners should be increased as soon as possible. In addition extending range of hydrogen concentration monitor should be done as well.

#### 2.3. Recommendations

R1.

#### 2.4. References

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## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

Issue Number	171
Section Number	6.3.3.2
Page	303

Facility	BNPP-1
Issue Title	Operational provisions for management of hydrogen inside the containment

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

Mitigation of the hydrogen risk is performed by PARs, which do not require operator actions in the course of the accident. The other aspect related to operator actions is operation of the containment spray system, which shall be arranged depending on specifics of BDBA.

#### 2.2. Comments

C1. The operator actions in operation of the containment spray system should be addressed.

#### 2.3. Recommendations

R1.

#### 2.4. References

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## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

	Issue Number	172
	Section Number	6.3.3.1
	Page	297
Facility	BNPP-1	
Issue Title	Design provisions, including means to restrict radioactive releases if prevention of overpressure requires steam/ gas relief from containment-1	

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

Current design does not foresee provisions to prevent over-pressurization of the containment in case BDBA when spray system is not available.  
 Report proposed to used plant design ventilation lines (TL09) for containment venting and implementing adequate measures to ensure robustness of venting lines possibly with their inerting; Implementation is defined as Long Term measure.  
 It should be also highlighted that “Analysis of the Bushehr NPP containment localizing functions performance at in-vessel and ex-vessel stages of BDBA” [18] does not include assessment of doses for the population. While SAST report has similar type of analysis for Dukovany NPP, this could not be credited as safety assessment for other type reactor, therefore additional analysis is necessary to perform.

#### 2.2. Comments

C1. The above mentioned analysis should be done.

#### 2.3. Recommendations

R1.

#### 2.4. References

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## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

Issue Number	173
Section Number	6.3.3.1
Page	297

Facility	BNPP-1
Issue Title	Design provisions, including means to restrict radioactive releases if prevention of overpressure requires steam/ gas relief from containment-2

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

Report does not provide specific information on availability of means for estimation of the amount of radioactive material released into the environment. The report recommends to perform analysis of radiological conditions; Implementation is defined as Medium Term measure, however in its description it is focused on accident management and lacks evaluation of doses to population. Analysis needs to be extended to cover this specific aspect.

#### 2.2. Comments

C1. Evaluation of doses to population should be considered in estimation of the amount of radioactive material released into the environment.

#### 2.3. Recommendations

R1.

#### 2.4. References

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	174
Section Number	6.3.4.1
Page	304

Facility -----

Issue Title Design provisions on prevention of re-criticality-1

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report states that reactor core or SFP re-criticality in severe accidents is very unlikely due to the inherent safety features (geometric configurations, use of the fixed neutron-absorbing materials etc); however report does not contain information on cliff-edge effects resulting from current design accident management measures related to re-criticality.

Re-criticality should be considered via analysis for relevant SAM strategies.

Implementation of SAMGs is defined as Medium Term measure.

#### **2.2. Comments**

C1. Information on cliff-edge effects resulting from current design accident management measures related to re-criticality should be presented.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

	Issue Number	175
	Section Number	6.3.4.1
	Page	304
Facility	BNPP-1	
Issue Title	Design provisions on prevention of re-criticality-2	

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report does not contain information on time before occurrence of cliff-edge effects resulting from current design accident management measures related to re-criticality. Report also states that issue of recriticality will be addressed in SAMGs related analyses; Implementation is defined as Medium Term measure.

#### **2.2. Comments**

C1. Information on time before occurrence of cliff-edge effects resulting from current design accident management measures related to re-criticality should be presented..

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	176
Section Number	6.3.4.1
Page	304

Facility	BNPP-1
Issue Title	Design provisions on prevention of re-criticality-3

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report does not contain information on suitability and availability of the instrumentation to identify re-criticality.  
Report also states that issue of recriticality will be addressed in SAMGs related analyses; Implementation is defined as Medium Term measure.

#### **2.2. Comments**

C1. Information on suitability and availability of the instrumentation to identify re-criticality should present.

#### **2.3. Recommendations**

R1.

#### **2.4. References**

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## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

Issue Number	177
Section Number	6.3.7.4
Page	309

Facility	BNPP-1
Issue Title	BDBA analysis

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

Report provides information regarding measures that would mitigate the conditions preventing staff from working in the main or secondary control room during the accident, however such an analysis was not done for BDBA. Timeframe for performing such an analysis is defined as Medium Term measure.

#### 2.2. Comments

C1. The analysis should be done for BDBA.

#### 2.3. Recommendations

R1. ---  
R2. ---

#### 2.4. References

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	178
Section Number	6.3.7.4
Page	309

Facility	BNPP-1
Issue Title	BDBA analysis

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides information regarding measures that would mitigate the conditions preventing staff from working in the main or secondary control room during the accident, however such an analysis was not done for BDBA. Timeframe for performing such an analysis is defined as Medium Term measure.

#### **2.2. Comments**

C1. The analysis should be done for BDBA.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	179
Section Number	6.3.8
Page	310

Facility	BNPP-1
Issue Title	Mobile equipment

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report provides information regarding the mobile equipment already available at BNPP (2MW/10 kV for power supply of large consumers and the diesel-generator 0.2 MW/400V for category 1 equipment) and also planned to be purchased, however currently neither connection points, nor procedures are developed even for equipment already available on-site. Time-frame for purchase of remaining additional equipment is also not defined.

#### **2.2. Comments**

- C1. The Connection points of mobile equipment information shall be provided.
- C2. Procedures shall be developed, even for equipment already available on-site.
- C3. Time-frame for purchase of remaining additional equipment shall be defined.

#### **2.3. Recommendations**

- R1. ---
- R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	180
Section Number	6.3.8.1
Page	310

Facility	BNPP-1
Issue Title	cliff-edge effect for instrumentation air

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides information on cliff-edge effects for I category batteries, that will be depleted in 2-3 hours

#### **2.2. Comments**

C1. The report does not provide information on cliff-edge effect for instrumentation air that might be necessary to open specific valves. This related information should be provided.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	181
Section Number	6.3.8.1
Page	310

Facility	BNPP-1
Issue Title	AC and DC power and compressed air instrumentation

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Suitability and availability of AC and DC power and compressed air instrumentation are not considered in cliff-edge effect analyses.

#### **2.2. Comments**

C1. Suitability and availability of AC and DC power and compressed air instrumentation should be considered in cliff-edge effect analysis.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)



## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	182
Section Number	6.3.8.1
Page	310

Facility	BNPP-1
Issue Title	cliff-edge effect analyses for BDBA

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides information regarding measures that would mitigate the conditions preventing staff from working in the main or secondary control room during the accident. Timeframe for performing such an analysis is defined as Medium Term measure.

#### **2.2. Comments**

C1. The habitability and accessibility of the vital areas of the NPP (the control room, emergency response facilities, local control and sampling points, repair possibilities) shall be considered in cliff-edge effect analyses for BDBA.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	183
Section Number	6.3.8.2
Page	310

Facility	BNPP-1
Issue Title	suitability and availability of the AC and DC power and compressed air instrumentation

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Suitability and availability of AC and DC power and compressed air instrumentation in cliff-edge effect analyses are not considered under development.

#### **2.2. Comments**

C1. It should be provided information for suitability and availability of the AC and DC power and compressed air instrumentation in cliff-edge effect analyses.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	184
Section Number	6.3.9
Page	311

Facility	BNPP-1
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Issue Title	Table 6-6
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### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report provides information on measuring/control Instrumentation applicable for accident management (table 6-6).

#### **2.2. Comments**

C1. There is lack of some information of environmental qualification such as: capability to withstand excessive pressure, temperature, radiation and duration of mode. It shall be considered all relevant information in the table 6-6.

C2. Hydrogen sensors listed in the report have limited by 5% upper level that is not sufficient for BDBA. It should be clarified.

#### **2.3. Recommendations**

R1. ---

R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	185
Section Number	6.3.10
Page	312

Facility BNPP-1

Issue Title Acceptance criteria on the adequacy of severe accident management

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report did not provide information on acceptance criteria on the adequacy of severe accident management systems for protection of containment integrity.

#### **2.2. Comments**

C1. It should be provided information on acceptance criteria on the adequacy of severe accident management systems for protection of containment integrity

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	186
Section Number	6.3.11
Page	313

Facility	BNPP-1
Issue Title	List of measures aimed at enhancing capability to maintain containment integrity

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

List of measures aimed at enhancing capability to maintain containment integrity after occurrence of severe fuel damage lists 14 areas where improvement of accident management approach is necessary; Implementation of those will require additional analyses and/or feasibility studies. Ten out of fourteen areas are covered by specific improvement measures presented in the SAST list for potential safety improvements and forecast for further work.

#### **2.2. Comments**

C1. Not all listed measures are related to maintaining containment integrity after severe fuel damage. List of measures aimed at enhancing capability to maintain containment integrity after occurrence of severe fuel damage should be identified.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### 1. ISSUE IDENTIFICATION

	Issue Number	187
	Section Number	6.3.11
	Page	313
Facility	BNPP-1	
Issue Title	List of measures aimed at enhancing capability to maintain containment integrity	

### 2. ISSUE CLARIFICATION

#### 2.1. Issue Description

The report lists some measures that could be potentially used to cool molten corium after a failure of the reactor vessel and improve containment heat removal - such as low-pressure top flooding of molten corium, corium spreading outside the reactor cavity, flooding the bottom of containment annulus, installation of diverse containment heat removal system. Implementation of these measures is subject to additional analyses and feasibility studies; Implementation is defined as Long Term measure.

#### 2.2. Comments

C1. The report does not provide specific information on high local dose rates on site or in some areas during the accident, but recommends doing respective analysis. All of specific information on high local dose rates on site or in some areas during the severe fuel damage taking into account impairment of work performance shall be provided.

#### 2.3. Recommendations

R1. ---  
R2. ---

#### 2.4. References

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	188
Section Number	6.3.11
Page	313

Facility	BNPP-1
Issue Title	measures which can enhancing capability to maintain containment integrity

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report does not provide specific information on potential of radioactive contamination and destruction of some facilities on site during the accident, but recommends doing respective analysis.

#### **2.2. Comments**

C1. List of measures which can enhancing capability to maintain containment integrity after severe fuel damage considering impairment of work performance due to radioactive containment and destruction of some facilities and site shall be developed.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	189
Section Number	6.3.11
Page	313

Facility	BNPP-1
Issue Title	Connection points and operational procedures for use of additional non-safety systems and mobile DGs

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report refers to assessment of additional equipment for cooling of molten corium after a failure of the reactor vessel and for containment heat removal (such as low-pressure top flooding of molten corium, corium spreading outside the reactor cavity, flooding the bottom of containment annulus, installation of diverse containment heat removal system).

#### **2.2. Comments**

C1. Cooling of corium and containment heat removal could be also arranged using mobile DGs and pumps. Connection points and operational procedures for use of additional non-safety systems and mobile DGs shall be developed/defined.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)



## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	190
Section Number	6.4.1.1
Page	314

Facility	BNPP-1
Issue Title	Radioactive releases after loss of containment integrity

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report refers to description of design provisions currently in place restricting the radioactive releases after the loss of containment integrity, namely annulus ventilation system, however use of this system would be possible only when electric power is available (restored, from EDG or mobile DG).

#### **2.2. Comments**

C1. It should be identified the situation when power is not available.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	191
Section Number	6.4.1.1
Page	314

Facility BNPP-1

Issue Title suitability and availability of the required instrumentation taken into account in cliff-edge effect analyses

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report does not contain information on suitability and availability of the instrumentation for whole progression of accident covering meltdown and relocation of the core.

#### **2.2. Comments**

C1. information on suitability and availability of the instrumentation for whole progression of accident covering meltdown and relocation of the core shall be provided.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	192
Section Number	6.4.1.1
Page	314

Facility	BNPP-1
Issue Title	analysis for BDBA and long-term measure

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides information regarding measures that would mitigate the conditions preventing staff from working in the main or secondary control room during the accident. Timeframe for performing such an analysis is defined as Medium Term measure.

#### **2.2. Comments**

C1. The analysis should be done for BDBA.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	193
Section Number	6.4.1.1
Page	314

Facility	BNPP-1
Issue Title	potential hydrogen accumulations in buildings

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report does not contain information on potential hydrogen accumulations in buildings other than containment

#### **2.2. Comments**

C1. Information on potential hydrogen accumulations in buildings other than containment shall be notified.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	194
Section Number	6.4.1.2
Page	178

Facility	BNPP-1
Issue Title	cliff-edge effects resulting from current operational provisions

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report did not identify of cliff-edge effects resulting from current operational provisions, but has clear focus on design provisions;

#### **2.2. Comments**

C1. Cliff-edge effects resulting from current operational provisions shall be identified.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	195
Section Number	6.4.1.2
Page	178

Facility	BNPP-1
Issue Title	Evaluation of time before cliff-edge effects

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report did not evaluate time before cliff-edge effects resulting from current operational provisions; however, the report indicates necessity implementation of the SAMGs and symptom-oriented EOPs for all plant and SFP operating modes.

#### **2.2. Comments**

C1. Evaluation of time before cliff-edge effects resulting from current operational provisions shall be identified.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	196
Section Number	6.4.1.2
Page	178

Facility	BNPP-1
Issue Title	suitability and availability of the instrumentation

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report does not contain information on suitability and availability of the instrumentation for whole progression of accident covering meltdown and relocation of the core, however report recommends performing assessment of functioning of instrumentation during beyond design basis conditions including severe accident or external hazards.

#### **2.2. Comments**

C1. Information on suitability and availability of the instrumentation for whole progression of accident covering meltdown and relocation of the core shall be given.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	197
Section Number	6.4.1.2
Page	178

Facility	BNPP-1
Issue Title	the conditions preventing staff from working in the main or secondary control room during the accident

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides information regarding measures that would mitigate the conditions preventing staff from working in the main or secondary control room during the accident. Timeframe for performing such an analysis is defined as Medium Term measure.

#### **2.2. Comments**

C1. Such an analysis should be done for BDBA.

#### **2.3. Recommendations**

R1. ---

R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)



## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	198
Section Number	6.4.1.2
Page	178

Facility	BNPP-1
Issue Title	Potential hydrogen accumulations in buildings

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report does not contain information on potential hydrogen accumulations in buildings other than containment.

#### **2.2. Comments**

C1. Information on potential hydrogen accumulations in buildings other than containment shall be provided.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	199
Section Number	6.4.2.1
Page	318

Facility	BNPP-1
Issue Title	Specific BNPP-1 analyses for progression of an accident in the SFP into SA conditions

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report provides information and description of design and operational provisions currently in place required for the accident management in the SFP, however according to SAST currently there is no specific BNPP-1 analyses for progression of an accident in the SFP into severe accident conditions.

#### **2.2. Comments**

C1. According to SAST currently, specific BNPP-1 analyses for progression of an accident in the SFP into severe accident conditions shall be provide.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	200
Section Number	6.4.2.1
Page	318

Facility	BNPP-1
Issue Title	Cliff-edge effect analysis

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report refers to PSA studies that defined the most hazardous mode of operation: Loss of residual heat removal in mode 6 with fuel partial unloading from the reactor to the SFP where uncover of fuel in SFP is expected to take place in ~26-30 hours, however cliff-edge effect analysis (table 6-7) does not consider this mode of operation.

#### **2.2. Comments**

C1. The report should explain why, or take into account this mode.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	201
Section Number	6.4.2.1
Page	318

Facility	BNPP-1
Issue Title	cliff-edge effect analysis

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report refers to PSA studies that defined the most hazardous mode of operation: Loss of residual heat removal in mode 6 with fuel partial unloading from the Reactor to the SFP where uncover of fuel in SFP is expected to take place in ~26-30 hours, however cliff-edge effect analysis (table 6-7) does not consider this mode of operation.

#### **2.2. Comments**

C1. The report should explain why, or take into account this mode.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	202
Section Number	6.4.2.1
Page	318

Facility	BNPP-1
Issue Title	Severe accident in SFP

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report did not reflect any specifics that might be applicable to severe accident in SFP.

#### **2.2. Comments**

C1. It should be noted that according to SAST currently there is no specific BNPP-1 analyses for progression of an accident in the SFP into severe accident conditions.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	203
Section Number	6.4.2.1
Page	318

Facility	BNPP-1
Issue Title	BDBA analysis

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides information regarding measures that would mitigate the conditions preventing staff from working in the main or secondary control room during the accident, however such an analysis was not done for BDBA.

#### **2.2. Comments**

C1. This analysis should be done for BDBA.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	204
Section Number	6.4.2.1
Page	318

Facility	BNPP-1
Issue Title	Simultaneously in the reactor and in the SFP for BNPP-1

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

According to SAST specific analyses of the severe accidents taking place simultaneously in the reactor and in the SFP for BNPP-1 are not available, but from the comparable analyses for standard WWER 1000/V320 reactor it could be concluded that the hydrogen removal system sized for the severe accident in the reactor will be also sufficient for parallel severe accident in SFP.

#### **2.2. Comments**

C1. Similar analysis should be also done for BNPP-1 in frame of SAMGs development.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	205
Section Number	6.4.2.2
Page	318

Facility	BNPP-1
Issue Title	accident management in the SFP

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The report provides information and description of design and operational provisions currently in place required for the accident management in the SFP.

BNPP design foresees the safety system for SFP cooling; currently there are no other dedicated delivery systems for SFP severe accident management. There is no diverse system for flooding/ spraying/ make up the SFP inventory using alternative water supply sources.

#### **2.2. Comments**

C1. According to SAST currently there is no specific BNPP-1 analyses for progression of an accident in the SFP into severe accident conditions. This specific BMPP-1 analysis should be done.

C2. Dedicated delivery systems for SFP severe accident management and diverse system for flooding/ spraying/ make up the SFP inventory using alternative water supply sources shall be specified.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)



## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	206
Section Number	6.4.2.2
Page	318

Facility	BNPP-1
Issue Title	Cliff-edge effect analysis

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report refers to PSA studies that defined the most hazardous mode of operation: Loss of residual heat removal in mode 6 with fuel partial unloading from the Reactor to the SFP where uncover of fuel in SFP is expected to take place in ~26-30 hours, however cliff-edge effect analysis (table 6-7) does not consider this mode of operation.

#### **2.2. Comments**

C1. The report should explain why, or take into account this mode.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	207
Section Number	6.4.2.2
Page	318

Facility	BNPP-1
Issue Title	severe accident in SFP

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report did not reflect any specifics that might be applicable to severe accident in SFP.

#### **2.2. Comments**

C1. It should be noted that according to SAST currently there is no specific BNPP-1 analyses for progression of an accident in the SFP into severe accident conditions.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	208
Section Number	6.4.2.2
Page	318

Facility	BNPP-1
Issue Title	BDBA analysis

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides information regarding measures that would mitigate the conditions preventing staff from working in the main or secondary control room during the accident, however such an analysis was not done for BDBA.

#### **2.2. Comments**

C1. This analysis should be done for BDBA.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	209
Section Number	6.4.2.3
Page	318

Facility	BNPP-1
Issue Title	Safety documentation

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

According to BNPP design the SFP is located inside the containment and thus restriction of radioactive releases is conditioned by maintaining integrity of the primary containment, however according to SAST currently there is no specific BNPP-1 analyses for progression of an accident in the SFP into severe accident conditions.

#### **2.2. Comments**

C1. Considering that reactor and SFP are located in one confinement, BNPP-1 safety documentation should be amended with analyses that will take into account parallel progression of severe accidents in both.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	210
Section Number	6.4.2.4
Page	319

Facility	BNPP-1
Issue Title	Radiological parameters

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

The SAST states that SFP is equipped with the instrumentation required for normal operation only (level/temperature).

Assessment of functioning of instrumentation during beyond design conditions including severe accident or external hazards is included in the Potential safety improvements and forecast for further work; Implementation is defined as short-term measure;

#### **2.2. Comments**

C1. ----  
C2. ---

#### **2.3. Recommendations**

R1. Radiological parameters could be measured by Confinement instrumentation.

R2. Assessment could be implemented in short term, modernization of monitoring system themselves is likely to be treated as Long Term measure.

#### **2.4. References**

(References which are used for the comments and recommendations)

## ISSUE SHEET

### **1. ISSUE IDENTIFICATION**

Issue Number	211
Section Number	6.4.2.5
Page	319

Facility	BNPP-1
Issue Title	BDBA analysis

### **2. ISSUE CLARIFICATION**

#### **2.1. Issue Description**

Report provides information regarding measures that would mitigate the conditions preventing staff from working in the main or secondary control room during the accident.

#### **2.2. Comments**

C1. The analysis should be done for BDBA.

#### **2.3. Recommendations**

R1. ---  
R2. ---

#### **2.4. References**

(References which are used for the comments and recommendations)

### **3. REFERENCES**

- 1- Regulation on Stress Tests of RRs, doc No: INRA-NS-RE-050-05/05-0-Oct.2018
- 2- Declaration of ENSREG, Annex 1 – EU “Stress tests” specification, ENSREG, 2011, 15 p.
- 3- Post-Fukushima „Stress tests“ of EU NPPs – Contents and format of national reports, HLG\_p(2011-16)\_85, ENSREG, 2011, 14 p.
- 4- Regulatory review guideline for Licensee/ operator’s stress test methodology and self-assessment stress test report of Iranian NPP, ENCO, April 2018, EUROPAID/138091/DH/ SER/ IR, project IRN3.01/16 LOT.1, 2017 Task 3