

A PRELIMINARY SURVEY OF WORLDWIDE ACTIVITIES BY RR OPERATORS FOLLOWING THE FUKUSHIMA-DAIICHI NPP FUEL MELTING

Y. BARNEA, N.D. PELD, P. ADELFGANG, A.M. SHOKR, H. ABOU YEHIA
International Atomic Energy Agency (IAEA),
Vienna,
Austria

Abstract

Following the core melting and the radiological consequences as a result of the accident at TEPCO's Fukushima-Daiichi (F-D) NPPs, there has been a worldwide movement to revise safety assessments of nuclear power installations. At the same time, the community of research reactor (RR) stakeholders, operators and regulators publically expressed their readiness to re-evaluate and update the safety status of their facilities, in case similar external events should occur. As there are important safety related topics to be checked and revised (e.g.: the seismic design, blackout and external events resulting in the loss of the ultimate heat sink, emergency organization/crisis preparedness, etc.), the first immediate step to assist the Member States (MS) to share the lessons learned from the events, the IAEA distributed a questionnaire. The purpose of this questionnaire is to collect from MS operating RRs preliminary information on the types of activities initiated as a result of the unprecedented F-D accident last March. The questionnaire contained two general questions and three specific questions with multiple proposed answers. For the specific questions, it was acceptable to mark more than one answer for each question. By October 2011, fifty six (56) answers were received, from 29 MS (out of 56 operating RRs). Only one out of three answered the first question by mentioning that no dedicated activity was requested after the F-D accident. Moreover, one out of five reported revisions in the DBA list as well as in the EPP, although only one out of three made changes in the EPP. Finally, two out of three answers indicated no changes in the utilization/operation plan following the lesson learned from the accident. It should be noted that it was not possible to measure the degree of completeness of the activity (i.e., whether the activity is considered, in progress, or completed). The paper's purpose is to present the responds to the questionnaire as and preliminary analyse the survey, in order to get information on the activities initiated by member research reactor operators following F-D accident so that IAEA follow-up activities on the subject within the research reactor cross cutting group are planned .

1. INTRODUCTION

As a result of TEPCO's Fukushima-Daiichi (F-D) nuclear power reactors accident, there has been a worldwide initiative to perform complementary safety assessments of nuclear installations. Correspondingly, the Research Reactors (RRs) community including stakeholders, operators and regulators expressed publically their readiness to re-evaluate and update the safety status of the facilities, facing a possibility of similar external events. Although the RRs are generating (on average) one thousand times lower energy than Nuclear Power Plants (NPPs), and their radioactive source term is significantly lower, there are important common safety topics to be checked (e.g. Siting and design provisions against external hazards, design basis accidents and safety margins considered in the safety demonstration, design provisions for ensuring basic safety functions, blackout initiated events, safety of spent fuel storage facilities within the reactor building, and emergency organization/crisis preparedness). In June 2011 the Technical Working Group for Research Reactors (TWGRR) advised the Agency to present in the International Conference on Research Reactors (Rabat, November 2011), the response of RR operators to the TEPCO's F-D nuclear power reactors accident, regarding the safety of their facilities [1].

The questionnaire is provided in the Annex. It contains two general questions and three specific questions with multiple proposed answers. For the specific questions, it was acceptable to mark more than one answer for each question. Due to time limitations and because of the nature of the accident, the targeted RRs were those facilities that have significant higher risk (RRs with a power level greater than 1 MW were selected). The

purpose of this questionnaire was to collect from Member States operating RRs preliminary information on the types of activities initiated as a result of the unprecedented accident. In the preparation of the questionnaires, the basic ideas from the recommended actions published for the NPP's F-D accident [2] (and relevant to RRs) were followed, including:

- Hardware preparation to protect the safety Systems, Structures and Components (SSCs) from external events;
- Preparation for variety of power sources;
- Consideration and preparation for variety of cooling systems;
- Adequate enhanced Emergency Preparedness Plans (EPPs).
- Hardware preparation for the AM such as multiple wiring for power source;
- Training and education of AM;
- AM for spent fuel storage facilities;
- Improvement of severe accident scenarios analysed and human resources development.
- Reassessment of public information disclosure and information sharing.
- Detailed evaluation for the seismic design, including updating the database.

2. THE PROFILE OF THE RESPONDING ORGANIZATIONS

By October 2011, 56 answers were received, from 29 MSs (out of 56 operating RRs). Non-operating organization (i.e., regulators) provided 10 answers, 6 replies were received from reactors with the maximum nominal power less than the threshold, 1 answer was received from a project manager of a RR under construction and 1 reply was from a decommissioned reactor. At this preliminary stage, the decision was to include in the report all the replied questionnaires. It should be mentioned that following the answers, it is impossible to measure the degree of completeness of the activity reported (i.e., whether the activity is considered, in progress, or completed).

3. RESULTS PROCESSING

The results received on the first general question: *What was done in your organization following the F-D event*, are depicted as a pie chart in Figure 1. The chart indicates that 69% of organizations surveyed launched some dedicated activities (all colours except blue) following the TEPCO's Fukushima-Daiichi reactors accident. Considering the specific activities performed, many organizations (red & orange & light blue & light green) reported a short re-evaluation of the Design Base Accidents list in the Safety Analysis Report (SAR) and/or a revision in the Emergency Preparedness Programme (EPP). Further comprehensive activities, such as including a complete re-evaluation of the SAR and of the EPP were reported by less number of organizations (green & orange & light green), as these considerable changes are usual requested and approved by the regulatory bodies, and therefore are included in a long term and complex process. The rest of the answers (purple & turquoise) are mentioning unspecified activities of revision the systems and/or the emergency procedures.

The second general question: *Considering the social impact and the public acceptance of RRs in your country, following the March 11 accident, how would you describe the impact of the F-D event*, was answered in many different ways, ranging from "no impact" to "serious consequences". Due the limited time to prepare the report before the conference, and the expected diversity of the answers, the results will be analysed and published in the upcoming planned future activities (see Chapter 4).

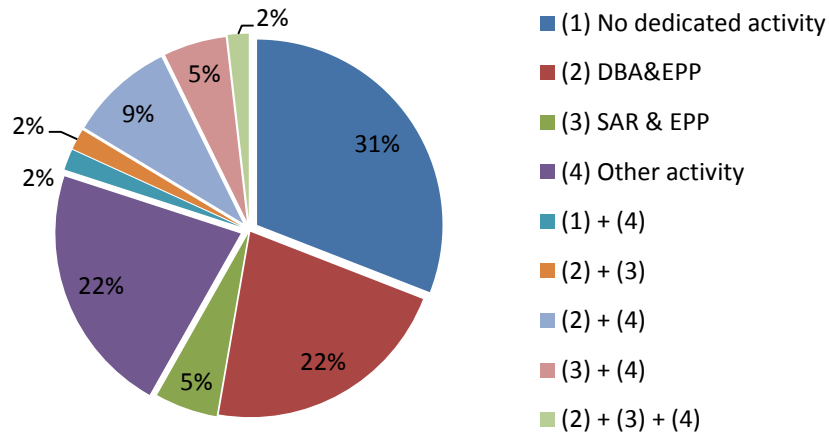


Fig. 1. Response to Question number 1: What was done in your organization following the F-D event?

On the specific following question: *Considering that the new Safety Assessment (SA) includes re-evaluation of the SAR and the safety margins, how can you describe the outcome of your actions*, the various answers are presented in Figure 2. Although only 4% (blue) included, or intend to include, new Postulated Initiating Events (PIE's), 18% (red) included a combination of accidental External Events, e.g., earthquake blackout, flooding & fire, etc... Moreover, 15% of the responds (turquoise) were indicating that they included, or intend to include, in the updated SAR additional new PIE's and to perform analyses of accidents resulted from combinations of external events. A very important result of the survey is that 11% (green) of the replies mentioned to include, or intend to include, new or updated database on the magnitude and probability of the external events. It should be noted that these considerable changes in the SAR require approval by the regulatory bodies, and therefore are completed in a longer timeframe. Additional 9% (light blue) reported to accomplish, or intend to do, all the process mentioned above which will be probably followed by a license renewal.

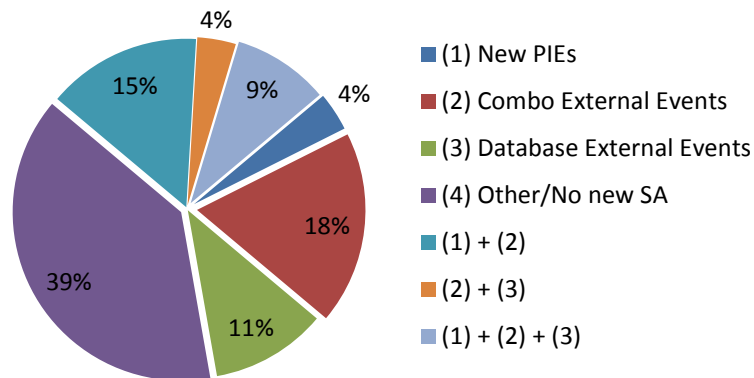


Fig. 2. Response to Question 3: How would you describe the outcome of the new Safety Assessment?

On the specific question: *considering the reactor Utilization/Operation plan, what was revised following the F-D event?* The replies are depicted in Figure 3. Considering the answers received, 16% (green & light green) reported the revision of the Ageing Management programme only, 2% changed also the OLC's (lavender) and the Safety Assessment (sky blue). Some organization (blue & light blue) decided to revise only the Operating Limiting Conditions (OLC's), and some (red & pink) performed only new Safety Assessment. The other 62% of the answers indicate that no action was taken in this context.

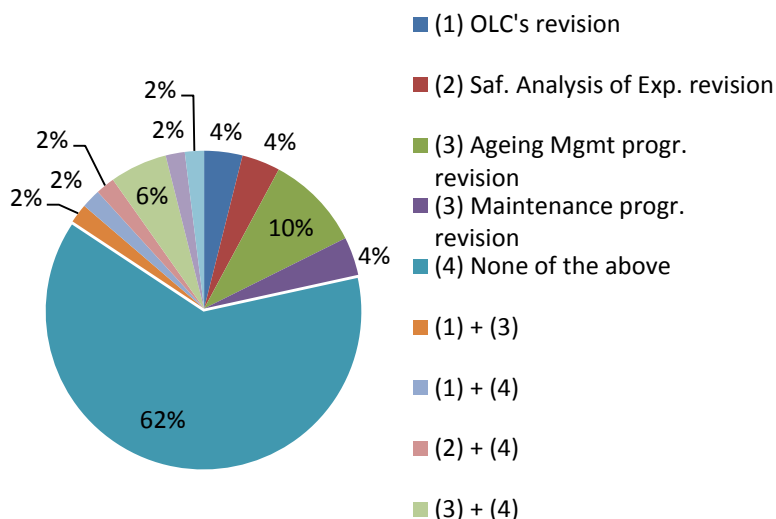


Fig. 3. Response to Question 4: What in the reactor utilization/operation plan was revised after F-D?

Finally, the fourth question refers to the Emergency Preparedness Plan (EPP): *considering the reactor EPP, what was asked for to be done following the F-D event*, and the answers are displayed in Figure 4. The answers indicate that 18% of the organizations revised the Emergency Response Programme (ERP), 6% (blue) prepared new Emergency Proceedings and 4% (green) upgraded the Emergency Equipment. Some of the answers reported combined activities of the above mentioned (orange & light blue and pink), where the most popular activity done by 14% (light blue) was to revise the ERP, and to upgrade the equipment needed for the emergency response accordingly. Nevertheless, 48% decided not to change their existing EPP. Once again, it should be mentioned and emphasized that changes in EPPs require approval by the regulatory bodies and therefore assumed to be completed in a longer term.

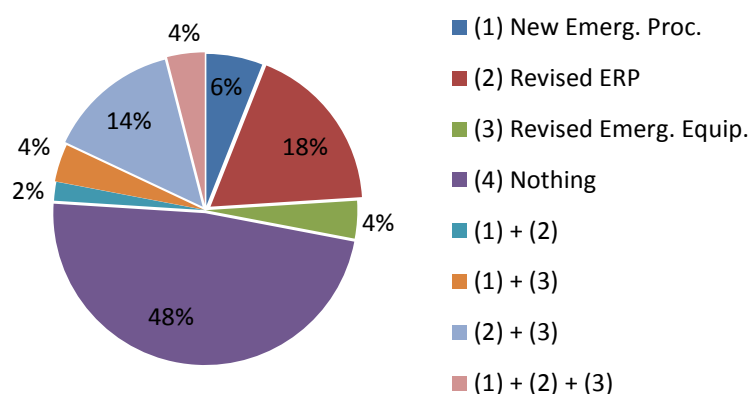


Fig. 4. Response to Question 5: Considering the reactor EPP, what was asked to be done following F-D?

4. CONCLUSIONS

Considering the preliminary surveillance, it is concluded that the responds to the questionnaire demonstrate that following the accident, many and various activities were initiated worldwide in the RR's facilities, regardless that the accident happened in a Nuclear Power station. Although, analysing the answers, it is presently impossible to determine whether the activities were concluded or not, the responds reflect an adequate mature and

serious reaction of the RRs community, following the unprecedented accident. Therefore the Agency Nuclear Safety and Security and Nuclear Energy Departments are organizing in May 2012 a cross-cutting Technical Meeting on “Implications of the Fukushima Accident on the Safety of Research Reactors.” Upon request from Member States, safety review missions will be also implemented to support Member States in addressing the implications of F-D accident to their research reactors. Moreover, in the upcoming months, as additional data is received by the Agency, a further examination of the survey results will be done, in order to draw the conclusions about the IAEA follow-up activities related to this subject. Furthermore, the updated results of the survey will be presented at the RRFM/IGORR upcoming meeting in March 2012 (Prague, CZ) and the TopSafe (Helsinki, FI) meeting in April 2012.

REFERENCES

- [1] INTERNATIONAL ATOMIC ENERGY AGENCY, Summary of TWGRR Meeting 2011, IAEA Working Material, (2011).
- [2] ATOMIC ENERGY SOCIETY OF JAPAN, Lessons Learned from the Accident at the Fukushima Daiichi Nuclear Power Plant, Technical Analysis Subcommittee, Committee for Nuclear Safety Investigation, Tokyo (2011), http://www.aesj.or.jp/en/release/gbcom_kyokun_EN_20110530.pdf.

ANNEX

Part A: General questions

1. What was done in your organization following the F-D event?

- No dedicated activity (e.g. as it was considered an event specific only to NPPs).
- Short re-evaluation of the Design-Basis Accidents (DBA's) and the Emergency Preparedness Plan (EPP).
- A complete re-evaluation of the Safety Analysis Report (SAR) and EPP.
- Other dedicated actions (please elaborate).

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2. Considering the social impact and the public acceptance of RRs in your country, following the March 11 accident, how would you describe the impact of the F-D event?

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Part B: Specific questions

3. Considering that the new Safety Assessment (SA) includes re-evaluation of the SAR and the safety margins, how can you describe the outcome of your actions?

- Included new Postulated Initiating Events (PIE's), e.g., no available power supply, etc.
- Included a combination of accidental External Events, e.g., earthquake & total loss of electrical power supply, flooding & fire, etc.
- Included new or updated database on the magnitude and probability of external events.
- None of the above (In this case, pls. describe your activity).

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4. Considering the reactor Utilization/Operation plan, what was revised following the F-D event?

- The Operating Limiting Conditions.
- The SA of high pressure and temperature experimental devices (e.g., criteria of design, PIEs, etc.)
- The Ageing Management programme.
- The maintenance programme concept.
- None of the above (In this case, pls. describe your activity)

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5. Considering the reactor EPP, what was asked for to be done following the F-D event?

- New/Update of Emergency Procedures. (e.g., classification, action levels, planning zones, etc.)
- Revision of the Emergency Response Plan.
- Revision/modification of the Emergency Equipment.
- None of the above. (In this case, pls. describe your activity).

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