Faults at the Tsuruga NPP

Summary Findings of the International Review

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Headline Findings

- JAPC has responded to our previous recommendations and collected new geological information about the Tsuruga site
- there is clear evidence that the K and G/D-1 faults at the Tsuruga NPP are not active: they have not moved in at least the last 120,000 to 130,000 years
- there is a sound scientific basis for JAPC and NRA to enter a dialogue on continuing and improving (*'kaizen'*) the seismic safety evaluation and management of the NPP

Context (1)

1. We have been asked to carry out an independent expert review of two JAPC reports (March and July 2013) on fracturing in the bedrock at Tsuruga NPP and to provide JAPC with our comments and recommendations.
2. Our team comprises scientists who are experts in geosciences, earthquake engineering and nuclear power, and work widely with government agencies, the nuclear power industry, nuclear regulatory authorities and international agencies, such as the IAEA. We are experienced in the provision of independent scientific advice to both industry and regulatory decision-makers who require clear, unbiased scientific information.

Context (2)

3. We have reviewed the two reports produced by JAPC scientists on geological aspects of the fractures at Tsuruga. Members of our group have visited the site and examined the rock formations and fractures in trenches, outcrops and drill-core. We have had detailed discussions with JAPC's staff and geological consultants.
4. We are familiar with the arguments presented by the NRA expert group on the fractures at the site and the differences in interpretation between these scientists and JAPC scientists.
5. We have provided JAPC with detailed comments and recommendations.

Principal Findings (1)

1. JAPC has carried out careful scientific investigations of the fractures that are of concern to NRA. These investigations have been designed to answer specific issues raised by NRA as well as to provide a background geological understanding of the fractures.
2. The latest report by JAPC contains new and additional geological information that clarifies issues raised by NRA experts in May 2013. We consider this new information to be a solid basis for renewed dialogue between JAPC and the NRA.

Principal Findings (2)

3. The main concern of NRA is that fractures 'K' and 'G/D-1' that lie close to or pass beneath Unit 2 could be 'active faults' or are fractures that could move sympathetically with an earthquake on the Urasoko Fault (which is known to have had episodic surface rupture every few thousand years).
4. We find that the JAPC investigations are sufficient to answer these specific concerns of NRA, although they do not comprise a comprehensive geological investigation. We return to this point later, in our recommendations.

Principal Findings (3)

5. JAPC has provided adequate and convincing evidence, in particular in the additional work that it has carried out since May 2013, that the fractures of concern to NRA are not 'active faults', as defined by NRA.
6. **We have seen clear evidence that these fractures have not moved at the site during at least the last 120,000 to 130,000 years – possibly longer.**
7. **We thus consider that the single, simple evaluation criterion of the presence or not of an 'active fault' beneath the nuclear facility has been resolved and is not, in itself, a basis for action.**

Principal Recommendations (1)

With respect to seismic hazard, we consider that the proper engineering approach to regulating and managing the Tsuruga NPP site requires deeper consideration than just the simple investigation of fault activity.

We thus make the following recommendations.

Principal Recommendations (2)

1. Tsuruga NPP Units 1 and 2 lie within a few hundred metres of the active Urasoko fault that could host a major (>M_W6) earthquake, so the nuclear facilities are susceptible to seismic hazard. Seismic hazard analyses that consider ground motion and shaking of the NPPs have been carried out in the past and we understand that JAPC continues to update these in the light of new information.

Principal Recommendations (3)

2. We recommend that the seismic hazard analysis of the NPP should be continually improved and updated with new data and techniques, as they arise ('living safety assessment'). It should be broadened to include all aspects of seismic hazards (in addition to seismic shaking), including the possibility of distributed fracture displacement near the facilities in the event of movement on the Urasoko fault. We consider this to be in-line with international best-practice, as recommended by the IAEA in its Safety Standards documents.

Principal Recommendations (4)

3. **We consider that JAPC and the NRA should work closely together to define and agree the scope and structure of such an assessment.** This is a similar approach to that used by the USNRC and the NPP operator at Diablo Canyon in California.

Principal Recommendations (5)

4. Such continued and extended analysis will require extension of the geological characterisation programme that has been carried out so far by JAPC, covering a wider area, gathering additional data and using additional techniques to interpret the scientific results. JAPC already has a wealth of information that could be integrated into such an analysis.
5. We consider that it would be valuable to subject this work to independent peer review.