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Case Histories in the Implementation of the IAEA Safety Guide on Seismic Hazard Analysis

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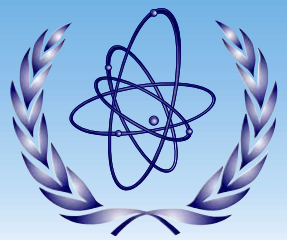

International Atomic Energy Agency

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Overview of the Reviewed Sites

- Gorki (USSR): New name of the city is Nizni Novgorod. Heat Generating Plant. The seismic hazard review was done within the scope of a design safety review of the plant. AEP Leningrad was the designer. (1989)
- Crimea (USSR): WWER 1000 under construction (never completed). Detailed review of seismic hazard including geological hazards (e.g. mud volcanoes)

Overview of the Reviewed Sites (Cont'd)

The seismic hazard studies were done by AEP Moscow with Ismes (Italy) as consultants. MEQ network operatied for several years. Many geophysical profiles and historical earthquake catalogues were reviewed. (1991)

- Smolensk NPP (RF): RBMK under operation. The seismic hazard review was part of the design safety review for the plant. The adequacy of the 0.1g minimum requirement was checked. (1993)

Overview of the Reviewed Sites (Cont'd)

- **Leningrad NPP (RF): RBMK under operation. The seismic hazard review was done within the scope of a general study of external hazards. The adequacy of the 0.1g requirement was checked. The work was performed by Russian consultants.(1999)**

- **Temelin NPP (Czechoslovakia): WWER 1000 at the time under construction. The seismic hazard review was done within the scope of a site safety review. Potential for geological hazards was considered. MEQ network operated for several years. The work was done by Czech consultants. The final study was PHSA. (1992 with a follow up in 2003)**

Overview of the Reviewed Sites (Cont'd)

- **Mochovce NPP (Slovakia): WWER 440/213. Started operation in The seismic hazard was reviewed during three missions, the last one in 2003. The work was done by Slovak, Czech and US consultants. Geological hazards (surface faulting issue) was considered. MEQ network operating. The final study was PHSA. (1994 – 2003)**

Overview of the Reviewed Sites (Cont'd)

- **Bohunice NPP (Slovakia): WWER 440/ 230 and 213. The process was similar to Mochovce except the final review was in 2000. Slovak and US consultants performed the work. Geological hazards were considered. MEQ network operating. PHSA was used throughout. (1994 – 2000)**

Overview of the Reviewed Sites (Cont'd)

- **Paks NPP (Hungary): WWER 440/213. Several interim missions were conducted to review the seismic hazard. Extensive work on geophysics (for fault identification) as well as a permanent MEQ network. A PSHA was performed and later extended for a seismic PSA. Geological hazards (surface faulting and liquefaction) were considered. Hungarian, UK and US consultants wre involved. IAEA involvement in the review process was intensive. (1993 – 1995)**

Overview of the Reviewed Sites (Cont'd)

- Cernavoda NPP (Romania): PHWR. The review of the PSHA (to be used in the seismic PSA) is presently (2003) ongoing. The work is performed by Romanian and US consultants .

- Pitesti RR (Romania): The seismic hazard review was done as part of the safety review of the research reactor. (2001)

Overview of the Reviewed Sites (Cont'd)

- **Kozloduy NPP (Bulgaria): WWER 440/230 and WWER 1000. The review of the seismic hazard was an intensive process with several interim and topical reviews. Geophysical studies were performed (or surface faulting) and a MEQ network was procured. The seismic hazard studies used both deterministic and probabilistic methods. Bulgarian and Macedonian consultants performed the work. (1991 – 1995)**

Overview of the Reviewed Sites (Cont'd)

- Belene NPP (Bulgaria): WWER 1000. At the time of the review the NPP was under construction. The seismic hazard review was performed as part of the site safety review. Several missions were made. MEQ network for a short period. The work was done mainly by Bulgarian consultants. Independent review was made by US consultants. IAEA involvement was from 1990 to 1994.

Overview of the Reviewed Sites (Cont'd)

- Krsko NPP (Slovenia): PWR Westinghouse. The PHSA was reviewed as part of the review of external events PSA for the plant. Geophysical work for identification of surface faulting. MEQ network. (1998)

Overview of the Reviewed Sites (Cont'd)

- **Medzamor NPP (Armenia): WWER 440/230. Several missions were conducted specifically for the seismic hazard review. Geophysical work was performed by Ismes. MEQ network deployed. Volcano hazard addressed. IAEA involvement started in 1991 and a final review mission for seismic safety (including hazard assessment) will be conducted this year (2003).**

Overview of the Reviewed Sites (Cont'd)

- Cekmece RR (Turkey): The IAEA involvement was mostly related to seismic re-evaluation of the facility and upgrading. Seismic hazard was evaluated by Turkish consultants. The strong motion instrumant at the site recorded ~0.2g during the 1999 Izmit Earthquake. (1999)

Overview of the Reviewed Sites (Cont'd)

- **Bushehr NPP (Iran): WWER 1000 (original plant was a German Konvoi). Several missions were performed specifically to review the seismic hazard. Very detailed geological, geophysical and seismological studies were performed by Russian and Iranian contractors. MEQ network. Surface faulting investigations. (1994 – 2000)**

Overview of the Reviewed Sites (Cont'd)

- Ulken (Kazakstan): NPP site near Lake Balkash. The review of seismic hazard was within the scope of site safety review. Work was performed by Russian and Kazak consultants. MEQ network. (1998)

- Alatau (Kazakstan): RR near Almati under operation. Main concern was surface faulting and extensive trenching was performed. (1997)

Overview of the Reviewed Sites (Cont'd)

- Ulugbek (Uzbeksitan): RR near Tashkent in operation. The seismic hazard review was part of the general seismic safety review of the RR. (1996)

- Rooppur (Bangladesh): NPP Site. The seismic hazard review was part of the general site safety review. (2000)

Overview of the Reviewed Sites (Cont'd)

- Chashma NPP (Pakistan): PWR 300MW Chinese design (now in operation). The seismic hazard studies were reviewed as part of the site safety review. Site vicinity field geological was reviewed in detail. The wok was performed by Pakistani consultants and Ismes. MEQ monitoring for a limited period. The review was done before construction started in 1991.

Overview of the Reviewed Sites (Cont'd)

- Kanupp NPP (Pakistan): PHWR in operation near Karachi. Seismic hazard was reviewed as part of the seismic safety program for the plant. The work was performed by Pakistani consultants. Several missions were conducted. (1997 – 1999)

Overview of the Reviewed Sites (Cont'd)

- **Muria (Indonesia): NPP Site North Central Java. The seismic hazard was reviewed as part of the site safety review during a period of about eight years. The studies are still not completely finalized. Volcanic hazard was also of concern. The work was performed by Indonesian and Japanese consultants. (1991 – 1999)**

Overview of the Reviewed Sites (Cont'd)

- **Madura (Indonesia): Site for a nuclear desalination plant. The first review was performed as part of the site survey review. (2002)**

- **Bangkok (Thailand): Site for a RR. The review was done as part of a site safety review. (1997)**

Overview of the Reviewed Sites (Cont'd)

- Ulchin NPP (Korea): PWR Korean design. The review was done as part of the external events PSA for the plant. Soil stability was also addressed. The work was done by Korean and US consultants. (1997)
- Sinpo (N. Korea): Site for a PWR Korean design to be built by KEDO. The review was done as part of the design review of the plant. The work was done by North and South Korean consultants. (2001)

Overview of the Reviewed Sites (Cont'd)

- Tianwan NPP (China): Site for a WWER 1000 (now under construction). Work was done by Chinese consultants. Some surface geology work and use of historical earthquake data. Limited MEQ monitoring. (1998)

Overview of the Reviewed Sites (Cont'd)

- Sidi Boulbra (Morocco): Site for NPP. Seismic hazard review was part of a site safety review which went on for almost ten years. The work was done by French and Moroccan consultants. Tsunami effects considered. MEQ monitoring an use of historical earthquake data. (1985 – 1993)

Overview of the Reviewed Sites (Cont'd)

- Maamora (Morocco): Site for a RR. The seismic hazard review was done as part of design safety review of the facility. The work was done by French, US and Moroccan consultants. (2001)
- Tantan (Morocco): Site for a desalination plant. The review was done as part of the feasibility study. The work was done by Chinese and Moroccan organizations. (1998)

Overview of the Reviewed Sites (Cont'd)

- **Inshas (Egypt): Site of an operating and a future RR. The review of the existing reactor site was done within the scope of a seismic safety review including surface faulting considerations. For the future RR (now constructed) the review was done as part of design safety review. (1993, 1997)**

Overview of the Reviewed Sites (Cont'd)

- Koeberg (South Africa): Site of a new NPP (PBMR). The review was conducted as part of the EIR review for the new facility. There is already an existing NPP (PWR) at the site with a unique sesimic isolation feature. (2000)

Overview of the Reviewed Sites (Cont'd)

- **Lucas Heights (Australia): Site of a RR (now under construction). The seismic hazard review was done as part of design review of the facility. Consultants from Australia and New Zealand performed the work. Surface faulting was also considered. (2001 – 2002)**

Overview of the Reviewed Sites (Cont'd)

- Santiago (Chile): RR in operation. The seismic hazard review was part of an integrated safety review of the RR. The main emphasis of the seismic part of the review was related to seismic vulnerabilities of the RR. (2002)