StrålevernRapport 2016

IMPLEMENTATION OF THE OBLIGATIONS OF THE CONVENTION ON NUCLEAR SAFETY IN NORWAY

The seventh Norwegian Report in Accordance with Article 5 of the Convention

Statens strålevern

Norwegian Radiation Protection Authority
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A Introduction

A.1 General

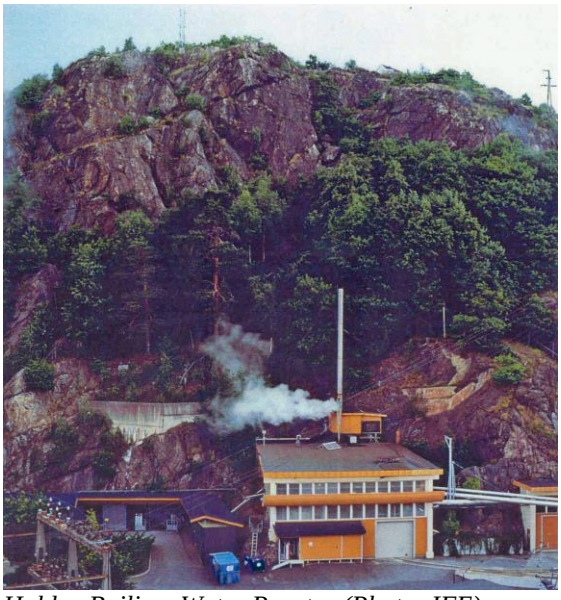
This report is issued according to Article 5 of the Convention on Nuclear Safety. Norway signed and ratified the Convention on 20 September 1994.

The report will give a brief overview over the nuclear research activities in Norway and describe briefly how Norway apply the different Articles to that activity. Part A of the report provides general information about the situation in Norway; however, Part B provides the article-by-article approach to show the compliance with the Convention in accordance with the guidelines provided in INFCIRC/572 Rev. 5 Part II.E. The principles from the Vienna Declaration are also taken into account. *Changes in the situation which have occurred since the sixth report to the Review Meeting in 2014 are written in italics*.

A.2 Nuclear Activities in Norway

The Norwegian nuclear activities were started in 1948 by the establishment of Institutt for Atomenergi (at present Institute for Energy Technology) at Kjeller north-east of Oslo. The first research reactor JEEP[1] I, reached criticality in July 1951. It was followed by HBWR[2] in 1959 (the OECD Halden Reactor Project). The N0RA[3] reactor at Kjeller came into operation in 1961. It was a zero effect reactor for establishing basic data, which at that time were not openly available. The JEEP I and the NORA reactors were shut down and decommissioned in 1967 and 1968, respectively. The JEEP II reactor was built in 1965-66 and reached criticality in December 1966. At present, the JEEP II at Kjeller and the HBWR in Halden are in operation. JEEP II has a thermal capacity of 2 MW. HBWR has a thermal capacity of 25 MW, but it is usually operated at less than 20 MW. Both reactors are owned and operated by the Institute for Energy Technology.

JEEP II at Kjeller (Photo: NRPA).



Halden Boiling Water Reactor (Photo: IFE).

A.3 The Institute for Energy Technology

The Institute for Energy Technology, IFE, is an independent and international research foundation for energy and nuclear technology. Part of its budget is financed by the Government through the Ministry of Trade, Industry and Fisheries and the rest is from research contracts with industry and other research institutions.

IFE's an annual turnover is approximately NOK 1 000 million (107 M€), of which around 14 % is governmental funding. With this basis, enough financial resources and staff are available for the safe operation of the two research reactors. At present, around 30 persons are employed at reactor operation at

[1] Joint Establishment Experimental Pile

[2] Halden Boiling heavy Water Reactor

[3] Norwegian zero effect Reactor Assembly

JEEP II and around 60 persons at HBWR. In addition more personnel are involved in radiation protection, waste handling, research etc.

A.4 The Regulatory Body

The regulatory body is the Norwegian Radiation Protection Authority, NRPA. Since 1993, NRPA has been an independent regulatory body under the Ministry of Health and Care Services.

As of the 1st January 2016 NRPA has been subordinate to the Norwegian Directorate of Health. With a few exceptions, the directorate has an overall professional and administrative responsibility for the Authority;

The Norwegian Radiation Protection Authority:

- *is the authority responsible for the area of nuclear security and non-proliferation*
- *has an autonomous decision-making authority following the Nuclear Energy Act directly subject to the Ministry of Health and Care Services*
- *has responsibilities and an autonomous decision-making authority following the Pollution Control Act directly subject to the Ministry of Climate and Environment*
- *has responsibilities to and carries out tasks for the Ministry of Foreign Affairs, including carrying out work on the Nuclear Action Plan and administering a subsidy programme*

The Directorate of Health is in charge of the Act and Regulations on Radiation Protection and use of Radiation.

The NRPA has kept its Director and leadership, and a budget based on a Letter of Disposition from the Directorate of Health.

The Ministry of Health and Care Services is considering a full integration of NRPA within the Directorate of Health. The Ministry of Foreign Affairs is currently conducting an assessment related to how Norway will fulfil the obligations and recommendations given by the IAEA Conventions, that Norway has signed and ratified, in the planned new governmental structure. Accordingly, the NRPA maintains***,*** ***at present***, the responsibility for nuclear safety, safeguards and security, and for national nuclear and radiological emergency preparedness and response. For radiation protection in medicine and industry and handling of radioactive substances, NRPA is co-organised with the Directorate of Health.

NRPA is organised in four departments:

- Department for Radiation Applications
- Department for Nuclear Safety, Emergency Preparedness and Environmental Radioactivity
- Department for Monitoring and Research
- Department for Planning and Administration

The departments are subdivided into specialised sections.

NRPA is also responsible for the State System of Accountancy and Control under the Safeguards Agreement between Norway and IAEA.

A.5 Implications of Extreme Events

After the Fukushima accident, Norway assessed the possible implications of extreme events. The so-called "stress tests" were performed by the IFE and assessed by NRPA. The conclusion was that the safety functions of the Norwegian nuclear facilities are robust enough to withstand severe accident scenarios. A couple of changes were made to keep the reactor and spent fuel pit safe against the worst-case scenarios.

A.6 Other Activities in the Nuclear Field

IFE is responsible for handling, storage and final disposal of radioactive waste excluding NORM, and for that purpose, the institute also operates the Combined Storage and Repository for Low and Medium Level Radioactive Waste. The combined storage and repository is located in Himdalen 25 km south-east of Kjeller. The capacity is about 10 000 barrels of waste, and it is expected to be filled around 2030.

The strategy for storage and final disposal of spent nuclear fuel has been under development

since the first official report on possible strategies issued in December 2001. Recent development is the findings that were presented by a commission in 2011, where the main recommendation was reprocessing of most of the fuel and that the HBWR site in Halden was the preferred site for an intermediate storage facility. *The process has developed further through a more thorough concept evaluation study (KVU). Two KVU reports were prepared by DNV GL with partners:*

1. Future Decommissioning of nuclear facilities in Norway

2. Handling of spent nuclear fuel and other radioactive waste in Norway

The recommendation given in these reports can be found on government website (https://www.regjeringen.no/contentassets/9ed6b7a312ea48c6a2b6705d1fcd82c3/kvu-dekommisjonering-rapport-og-vedlegg-5-11.pdf.

According to guidelines set by Ministry of Finance these studies have undergone a QA program. The final report of this QA was issued in April 2016. Further details of the waste management system will be reported under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

The Combined Storage and Repository for Low and Medium Level Radioactive Waste in Himdalen Photo: NRPA)

A.7 International Cooperation

In 1995, The Government of Norway issued its first plan of action to enhance safety and reduce the threat to the environment from the nuclear activities in the former Soviet Union, especially in the north-west region of the Russian Federation. The plan has been updated several times, most recently in 2013. The work is funded through the Royal Ministry of Foreign Affairs and NRPA is responsible for managing the funds. The main objectives of this work are to minimize the risk of accidents and preventing radioactive material of falling into the wrong hands.

The Chernobyl accident affected Norway by considerable fallout. Our experiences from the remediation efforts over more than 25 years are made available to Japan to assist them in their efforts to handle the effects of radioactive releases after the Fukushima accident.

NRPA has been engaged in several other projects within nuclear safety, the most prominent one at present is a cooperation project with the Romanian nuclear authority, which is implemented in close cooperation with IAEA. NRPA also takes part in activities under OECD/NEA, WENRA etc.

Norway has strongly supported the Action Plan on Nuclear Safety issued by the IAEA Board of Governors in 2011. It is of paramount importance that the existing mechanisms and international conventions remain vital, and Norway will continue its active participation in these forums and will continue to support all actions aimed at enhancing nuclear safety worldwide. We see the coming CNS meeting and the work to strengthen the international regimes for nuclear safety through i.e. the Convention on Nuclear Safety as very important in the future.

B Compliance with Articles 4 to 19

Article 4: IMPLEMENTING MEASURES

The measures to fulfil the obligations of the Convention are discussed in this report.

Article 5: REPORTING

The present report constitutes the *seventh* Norwegian report issued in accordance with Article 5.

Article 6: EXISTING NUCLEAR INSTALLATIONS

Norway has, two research reactors:

1. JEEP II at Kjeller. Heavy water pool reactor with thermal capacity 2 MW.
2. HBWR in Halden. Boiling heavy water reactor with maximum thermal capacity of 25 MW. A smaller part of the thermal capacity is sold to a company as an energy source in their industrial production

Article 7: LEGISLATIVE AND REGULATORY FRAMEWORK

All nuclear activities are regulated by three legal instruments, the Atomic Energy Act 12 May 1972, the Radiation Protection Act 12 May 2000 and the Pollution Control Act 13 March 1981.

The Atomic Energy Act regulates the licensing regime, general requirements for licences, inspection regime and the legal basis for the regulatory body. The Act also establishes the liability regime according to the Paris Convention of 29 July 1960 as amended and related international legal instruments. The last part of the Act regulates confidentiality and penalties in case of non-compliance.

Pursuant to the Atomic Energy Act, there are four regulations issued:

- Regulations 2 November 1984 on the Physical Protection of Nuclear Material and Nuclear Facilities (amended 29 June 2007).
- Regulations 15 November 1985 on Exemption from the Act on Atomic Energy Activity for Small Amounts of Nuclear Material.
- Regulations 12 May 2000 on Possession, Transfer and Transportation of Nuclear Material and Dual-use Equipment.
- Regulations 14 December 2001 on Economical Compensation after Nuclear Accidents.

The regulations 2 November 1984 establish requirements for the physical protection of nuclear material and nuclear facilities. The regulations implement Nuclear Security Series 13 and the obligations of the Convention of the Physical Protection of Nuclear Material and Nuclear Facilities as amended 2005.

The regulations 15 November 1985 exempt small amounts of nuclear material from Chapter III of the Act and thus from the liability regime.

The regulations 12 May 2000 regulate the control and accountancy of nuclear material as required in the Additional Protocol to the Safeguards Agreement between Norway and IAEA.

The regulations 14 December 2001 regulate how Contracting Parties to the Vienna Convention of 21 May 1963, Contracting Parties to the Joint Protocol of 21 September 1988 and Hong Kong shall be considered in connection to Norwegian legislation on nuclear liability. It also regulates how nuclear accidents in a non-party state shall be considered in connection to the Norwegian legislation.

Royal Decree 28 November 2008 on Licence for Operation of Nuclear Installations pursuant to the Atomic Energy Act issued to the Institute for Energy Technology. The licence expires 31 December 2018 except for the licence for HBWR, which expired 31 December 2014. *HBWR got its licence renewed by Royal Decree of 5 November 2013 with an expiry of 31 December 2020.* The main basis for the licence is the Safety Analysis Reports for the two reactors and the connected auxiliary facilities.

The Radiation Protection Act constitutes the legal basis for regulating the use of ionising

and non-ionising radiation, radiation protection requirements, medical use of radiation, contingency planning, waste management and discharges to the environment. The Act itself establishes the framework, given in more detail in the Regulations on Radiation Protection and Use of Radiation of 29 October 2010.

The Pollution Control Act regulates the risk of pollution, the authorisation regime for discharges of radioactive substances and the waste treatment regime. The application of this act is stipulated in regulations of which the most relevant one to the Convention on Nuclear Safety are:

Regulations 1 November 2010 on the Application of the Pollution Control Act on Radioactive Pollution and Radioactive Waste. Further description of these regulations is found in our national report to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

The Royal Decree of 23 August 2013 describes the organisation and mandate of the emergency preparedness and response system in Norway. This is further described under Article 16.

Article 8: REGULATORY BODY

Organisation

The regulatory body is the Norwegian Radiation Protection Authority, NRPA. Since 1993, NRPA has been an independent regulatory body under the ministry of Health and Care Services.

As of January 1 2016 the NRPA has been subordinate to the Norwegian Directorate of Health. With a few exceptions, the directorate has an overall professional and administrative responsibility for the Authority;

The Norwegian Radiation Protection Authority:

- *is the authority responsible for the area of nuclear security and non-proliferation*
- *has an autonomous decision-making authority following the Nuclear Energy Act directly subject to the Ministry of Health and Care Services*
- *has responsibilities and an autonomous decision-making authority following the Pollution Control Act directly subject to the Ministry of Climate and Environment*
- *has responsibilities to and carries out tasks for the Ministry of Foreign Affairs, including carrying out work on the Nuclear Action Plan and administering a subsidy programme*

The Directorate of Health is in charge of the Act and Regulations on Radiation Protection and use of Radiation.

The purpose was to ensure a more efficient health sector.

The NRPA has kept its Director and leadership, should have its budget based on a Letter of Disposition from the Directorate of Health.

The NRPAs previous chapter in the national budget has been removed and accordingly NRPAs is under the Directorate of Health's budget chapter, accordingly the NRPA has lost autonomy over its budget as a result of the reorganisation.

The NRPA maintains at *present*, the responsibility for nuclear safety, safeguards and security, and for national nuclear and radiological emergency preparedness and response. NRPA also administers the Act on Nuclear Energy Activities and report directly to the Ministry of Health under this act.

The Directorate of Health is also responsible for developing a further integration of the NRPA in relation to the national nuclear and radiological emergency preparedness and response to strengthen the overall health emergency preparedness. This is not yet in place.

The Ministry of Health and Care Services is considering a full integration of the NRPA within the Directorate of Health. The ministry of Foreign Affairs is currently conducting an assessment related to if and how Norway will be able to fulfil the obligations and recommendations given by the IAEA Conventions that Norway has signed and ratified.

NRPA is organised in four departments:

- Department for Radiation Applications

- Department for Nuclear Safety, Emergency Preparedness, and Environmental Radioactivity
- Department for Monitoring and Research
- Department for Planning and Administration

The Department for Radiation Applications is responsible for the supervision of industrial and medical use of radiation and radiation protection.

The Department for Nuclear Safety, Emergency Preparedness and Environmental Radioactivity acts as the secretariat for the emergency preparedness organisation against nuclear accidents, ref. article 16. It is also responsible for the supervision of the safety, security and safeguards of the nuclear facilities, regulation of environmental and health consequences of discharges of radioactive substances from nuclear, industrial and medical facilities. The 4 to 5 people mainly engaged in nuclear safety regulation belong to this department.

The Department for Monitoring and Research is responsible for the environmental monitoring and assessment as well as research projects in the same area.

The departments are further divided into specialised sections.

NRPA is mainly funded through the government, i.e. the budget chapters of the Ministry of Health and Social Care and the Ministry of the Environment. Fees are taken from the operator of the nuclear facilities for license hearing and assessment and for inspection activities. However, this constitutes a minor part of the total budget.

As a result of the restructuring, the NRPA will receive its funding from the Ministry of Health and Care, but through a letter of disposition from the Directorate of Healths budget chapter.

By the end of 2015, NRPA had a total staff of 124 persons and a total annual budget of around 250 MNOK (~26 M€). NRPA acts as a directorate under the Ministry of Foreign Affairs in carrying out the plan of action for cooperation with the Russian Federation. In addition to this, NRPA is funded from other governmental sources for miscellaneous projects.

Rulemaking

According to the Atomic Energy Act, the power to establish regulations is given to the Ministry of Health and Care Services or to the Government. However, NRPA is the expert authority in all safety (and security) matters, hence no regulations will be changed without the knowledge of NRPA.

Licensing activities

Applications for licences and renewals of licences for the operation of nuclear facilities are submitted to the Ministry of Health and Care Services. On behalf of the ministry, NRPA assess the applications. The assessment with recommendations is then sent to the ministry for further hearing and decision. Licence is finally given by the Government. NRPA also carries out regular inspections and audits to ensure that the requirements of a licence are fulfilled.

As a part of the relicensing procedure, an INSARR-mission was organised by IAEA on request from NRPA in June 2007 to HBWR site in Halden. In September 2010, a follow-up mission was organised.

The general conclusion of the INSARR-team was that there are no major safety issues that prevent continued operation of HBWR. The implementation of the recommendations from the INSARR-team is reported under article 10.

Inspection activities

Taking a graded approach into account, the inspection regime for two research reactors is smaller than for power reactors. NRPA is continuously monitoring the operation of the reactor facilities through weekly reporting of the operation, monthly/bimonthly reporting on radiation doses to the staff and annual reports on the operation of all nuclear facilities. The safety of the facilities is supervised by inspections and assessments as deemed

necessary between the reporting milestones mentioned under Article 9.

NRPA avails itself of the possibility to engage external consultants when reviewing the safety of the reactor facilities and other aspects of the activities on the two sites. In line with this, IPPAS-missions were organised by IAEA and carried out in September/October 2003 *and in October 2015.* A follow-up is planned to be held in the coming years. An INSARR-mission was carried out in 2007 with a follow-up in 2010.

NRPA is also responsible for the State System of Accountancy and Control under the Safeguards Agreement between Norway and IAEA.

Training and external cooperation

On the job training is used extensively together with different kinds of seminars. Staff from NRPA regularly takes part in training courses and seminars to enhance its competence. Some of the IAEA training courses have been very valuable to enhance our competence.

The Nordic Committee for Nuclear Safety Research has in this respect for a long time been a part of the portfolio of NRPA, for the recent time mostly for emergency preparedness.

Article 9: RESPONSIBILITY OF THE LICENCE HOLDER

The Institute for Energy Technology is the licence holder for the two research reactors and for the operation of the low and intermediate level waste repository. It is their responsibility to keep the safety in accordance with the licence requirements and appropriate international standards and to provide the necessary financial and human resources needed for keeping the safety at an appropriate level.

A Safety Analysis Report, SAR, of the facilities is the basis for the license application. The SAR follow the recommendations given in IAEA Safety Standards Series NS-R-4 and IAEA Safety Series No. SSG-20 and covers *inter alia* a description of the facilities (including OLCs and safety systems), radiation protection work, emergency preparedness, management system, administrative rules and organization.

As all licences are reviewed at least every ten years, this means a more or less continuous revision of the SAR. *And since the ministries gradually have shortened the licence durations, the licencing of the HBWR and the rest of the nuclear facilities have got out of phase with each other. NRPA has in this way got more work related to licence issues than before.* The updating of the SAR is an important requirement in the licence.

The experimental programmes have to be kept within the safety requirements of the licence and the SAR. If new experiments outside this framework are to be carried out, IFE must apply for appropriate changes in the license conditions.

As a license requirement, a status report on the safety of the installations is to be issued annually. This report is issued to confirm that the safety of the facilities still conforms to the requirements set up in the licence documents that are based on the Safety Analysis Reports for the facilities. Verification by analysis, surveillance, testing and inspection is also a part of the licensing process. This type of verifications also constitutes a part of the preparation of the reactors before every start up for a new experimental cycle.

For HBWR, the ageing management is primarily related to the reactor pressure vessel and the primary system. A material surveillance program was established in 1958 and samples of the original vessel material have been irradiated since then to be able to predict the behaviour of the reactor tank. In addition, a Service Inspection Programme is established and implemented in accordance with the applicable ASME[4] Code. External experts[5] are consulted by the operator for independent investigation and assessment of the condition of the reactor pressure vessel. Although most other parts have been changed since the construction of the reactor, the ageing management program extends to these parts of the facility as well. The Directorate for Civil Protection and Emergency Planning supervises

[4] American Society of Mechanical Engineers

[5] TÜV Nord Sweden AB

the ageing management program in addition to the supervision by NRPA.

The JEEP II reactor has an ageing supervision programme. As it passes 50 years of operation in December 2016, an ageing management program similar to the one used in Halden is implemented. As in Halden, the TÜV Nord is hired as an external consultant to develop an independent age management program.

Article 10: PRIORITY TO SAFETY

IFE invests considerable resources in safety and by this shows that the safety has a high priority, both for the reactor safety and for the radiation protection of the staff. Long shut down periods to prepare for experimental work gives room for improvements of the safety as well. The main tool for keeping the doses to the staff as low as reasonably achievable has been intensive monitoring and planning of the work.

The research projects run at the HBWR are aimed at enhancing the nuclear safety at civilian nuclear facilities worldwide. The HBWR is part of the OECD Halden Reactor Project, which is a co-sponsored research programme involving 18 countries, with the OECD Nuclear Energy Agency as the umbrella organisation. Main research activities at the OECD Halden Reactor Project are fuel and material safety research; and man, technology and organisational (MTO) research. In addition, there are numerous bilateral projects, which aim at fuel and material research and MTO research.

The JEEP II reactor is located in Kjeller. The reactor is used for basic research in neutron physics, material science, irradiation of silicon, and production of radioisotopes.

According to the licence requirements, IFE organises the necessary training and refresher courses for their staff at Kjeller and in Halden. NRPA ensures through inspections and audits that the resources and training/retraining provided are adequate.

IFE has established a comprehensive system for quality management of health, safety and environment including the research reactors and the waste repository. This management system takes care of all aspects of operating a nuclear facility as well as the general labour safety issues.

NRPA supervises the management system as well as the safety and security of the facilities. Other safety authorities being responsible for the non-nuclear part of the activity at the Institute is also performing supervision and inspections. The management system is also audited by customers as a part of commercial research contracts.

Fire protection has been improved by a thorough fire protection analysis, installation of additional fire detectors and minimizing the amount of combustible material in the facility.

The safety culture has been focused in the intensified surveillance and inspection regime of NRPA and effort is being done to keep it to a high standard by an increased awareness of the subject.

The improvement of the radiation protection zoning in the entrance tunnel required considerable rearrangement of equipment to accommodate an acceptable solution for the barriers and changing rooms between the radiation protection zones. *The zoning has now been completed.*

Article 15: RADIATION PROTECTION

In accordance with the Radiation Protection Act with regulations, any user of ionising radiation is committed to measure the radiation doses to workers that have been exposed to ionising radiation. The annual dose for each worker should be kept below the ICRP limits as set out in their Publications 103. IFE is, as a nuclear operator, responsible for its own dose registration system.

IFE measures individual whole-body dose, skin dose, finger dose and internal dose. The whole-body dose for the last 12 months is reported monthly/bimonthly for each worker, while the other dose measurements are reported annually to NRPA.

IFE has a system for work planning to keep the doses to the staff as low as reasonably achievable especially during maintenance work. A substantial reduction of the dose burden to the staff was achieved when this was introduced. The dose burden to the workers has

stayed at this level, and a reduction of the dose burden is sought wherever possible.

As a part of the discharge authorisation, doses to members of the public from releases of radioactivity have to be kept below 1 μSv/y for releases to the aquatic environment. For discharges to the air, the dose limit is 100 μSv/y. These are applicable to each of the facilities individually. NRPA establish release limits in Becquerel according to this, and the real releases are a fraction of the limits.

Article 16: EMERGENCY PREPAREDNESS

A: The National System

General

In general, the licensee is responsible for organising plans for on-site emergency preparedness and response. IFE has adapted plans for each site, and these are exercised regularly. The off-site response is planned by the local police authorities and coordinated with the Crisis Committee (see below).

Based on the Royal Decree 23 August 2013, the Government has established a national response organisation made up of representatives from the following entities:

- the relevant ministries;
- the Ministerial Coordination Committee;
- the Crisis Committee for Nuclear Preparedness (CCNP);
- the Advisors to the Crisis Committee;
- the Secretariat for the Crisis Committee (NRPA);
- the regional emergency organisations.

The ministries

The ministries are responsible for emergency preparedness within their area of competence. In order to deal effectively with the early phase of a nuclear event, the ministries have transferred responsibility for remedial actions to the Crisis Committee.

The Ministerial Coordination Committee

The Ministerial Coordination Committee is responsible for ensuring cooperation and coordination between the different ministries. The Ministry of Health and Care Services heads the Committee.

The Crisis Committee

The Crisis Committee consists of representatives from the following institutions:

- the Norwegian Radiation Protection Authority;
- the National Police Directorate;
- the Norwegian Defence Staff;
- the Directorate for Civil Protection and Emergency Planning;
- the Directorate for Health and Social Affairs and
- the Norwegian Food Safety Authority.
- *The Norwegian Coastal Administration*
- *The Royal Ministry of Foreign Affairs*

The Crisis Committee is responsible for implementing remedial actions in case of a nuclear event representing a potential threat to Norway, or Norwegian citizens and interests. The Committee decides:

- to initiate the evacuation of the population if the situation represents a direct threat to health and life;
- provide shelter, administer stable iodine, block and secure contaminated areas;
- to initiate a sheltering in place advisory
- in the short term restrict production and distribution of foodstuffs;
- advise on dairy products and other dose-reducing actions.

NRPA heads the Crisis Committee. The NRPA is also mandated to make the same decisions as the Crisis Committee until the Committee is assembled. Whenever possible, the Crisis Committee must consult with the ministries before deciding on actions.

Another consequence of the planned restructuring is that the Directorate of Health will take over the lead of the Crisis Committee primo 2018.

Emergency Levels

The Crisis Committee operates with three emergency levels: "0", "1" and "2". These apply to accidents domestic as well as internationally. Level "0" is operation as usual, level "1" is declared when a situation of significance occurs, which might develop in severity. Level "2" is declared when there is a risk of radiological consequences.

No countermeasures are automatically implemented on the basis of declared levels of emergency. Rather, they are implemented based on the type of dimensioning scenario faced as well as the assessment of the situation (see below)

The Advisors to the Crisis Committee

The Advisors to the Crisis Committee are made up of representatives from organisations and institutions, with expertise and responsibility required for an emergency organisation; with regards to the management of nuclear accident situations, and for further development and maintenance of emergency preparedness.

During an event, the tasks of the Advisors are to:

- submit and share all information, data, and measurements of relevance to the event
- forecast radioactive dispersion, fallout, and radiation doses to the public
- advise the Crisis Committee on preventing or reducing the radiological and economic consequences of a nuclear accident affecting Norway, or Norwegian interests.

The Secretariat for the Crisis Committee

The Secretariat for the Crisis Committee (NRPA) is responsible, *inter alia*, for alerting the Nuclear Emergency Organisation, and relevant international bodies. The Secretariat organises a 24/7 Officer on Duty Service.

The Regional Emergency Organisations

The Country Governors direct the regional emergency organisations. They coordinate regional and local emergency preparedness and response. Their responsibilities include: planning and initiating countermeasures in accordance with local needs and demands, and continuously liaise with the Crisis Committee.

Standing Preparedness

Norway operates a national automatic gamma monitoring network, consisting of 34 continuously run stations. One station is operated by the Norwegian Defence, however, the NRPA has access to the data. A mobile monitoring unit is also available. The data acquired is directly available to the competent authority, the emergency response organisation, and the public via radnett.nrpa.no.

In addition, Norway has 5 high volume air samplers, where 4 have alarm capabilities with GM-counters on top of the filters.

The Nordic countries have established an agreement that makes all the data from the national automatic gamma monitoring networks directly available to each other. Similar agreements are in place with the rest of the Baltic Sea countries.

Norway has established bilateral agreements on early notification with Finland, Germany, Lithuania, the Netherlands, Poland, Russia, Sweden, Ukraine, and United Kingdom. The agreements differ slightly in wording, but are based on the IAEA Convention of Early Notification from 1986. These agreements will ensure an early notification if an event occurs at a facility covered by the agreements.

B: Dimensioning Scenarios

The Crisis Committee has recommended six dimensioning scenarios as a basis for the national emergency planning:

1. large airborne release from foreign facility;
2. large airborne release from domestic facility;
3. local event with mobile source;
4. local event that develops over time;
5. release (or rumour of release) to marine environment;
6. serious accident abroad that can affect Norwegian interests, but not territory.

These scenarios have been approved at a ministerial level. The dimensioning scenarios are meant to assist the Crisis Committee in

prioritising, meet the needs, and plan for a best possible emergency preparedness. Dimensioning scenarios take into account the consequences to life, health, environment, society, and economy.

Exercises

The NRPA contributes to exercise activity on many levels of the response organisation. In previous years there has been a major focus on enhancing the competence of nuclear and radiological response on the regional level. In 2013, the NRPA participated in a Nordic-Baltic exercise (NB8). The NRPA participates in regular exercises among the Nordic countries: i.e. the REFOX exercise in Sweden in September 2012. The NRPA also participates in most of the IAEA Convex exercises when arranged. These exercises are valuable training opportunities for the NRPA staff and the CCNP.

Norwegian emergency response arrangements are exercised on the national, regional, and local levels. Relevant scenarios include: satellite crash, nuclear submarine accidents, nuclear ice-breaker accidents, transport accidents, dirty bombs, etc. Orphan sources are found every now and then, helping maintaining a high awareness of such incidents. There is no predefined regularity in these exercises.

IFE has adapted emergency plans for each site, and exercises these regularly.

Emergency Preparedness and Response and Post-Accident Management (Off-Site)

NRPA has conducted an evaluation of its own performance during the event in Fukushima and will take due note of the findings. The review includes a survey among main actors in the media, analysing their interaction with the NRPA, and the information they received during the crisis. In addition, a survey among the general public was conducted. The conclusions were largely that the NRPA was able to manage the crisis to the satisfaction of the concerned stakeholders; the media, governmental bodies, and the public.

The results of the stress testing of the Norwegian facilities show that there are no real changes in the threat assessment. Major changes in the emergency organisation are thus not necessary. However, the lessons learned from the crisis will be taken into account in the future work to enhance the effectiveness of the emergency organisation.

C: Severe Accident Management and Recovery (On-Site)

The analysis of the consequences of the most severe accident have also been reviewed; the loss of coolant with simultaneous loss of several emergency systems. Such an event will lead to release to the environment surrounding the reactor facility. The calculations have so far shown doses to members of the public below the IAEA recommended guidelines for emergency situations. These results were confirmed in the present review.

The plans for emergency preparedness are based on the scenarios described in the Safety Reports. IFE concludes that there is no need for any major changes as a result of the analysis.

However, the review identified that in a complete blackout situation the communication relying on electronic means, e.g. phone, fax, and e-mail, would become unavailable. This includes difficulties in getting reactor status in the case of an emergency. IFE will further assess such a situation, and will consider holding exercises without the use of the normal electronic communication infrastructure. A need to review the type, number and location of equipment for such emergency situations was also identified.

The NRPA has taken note of the information given by IFE, and awaits the final results.

Article 17: SITING

Construction of nuclear power plants or new research reactor is not planned in the near future. However, in the light of the Fukushima accident, assessments relevant to the sites have been made:

In accordance with IAEA Safety Standards Series No. NS-R-4 “Safety of research Reactors” Appendix 1, a number of postulated initiating external events had been analysed and documented in the Safety Analysis Reports of the IFE facilities. This was a requirement in the licensing process. The safety analysis

performed by IFE have been based on very conservative assumptions, and the safety margins are rather large. IFE has made a review of these analyses after the Fukushima accident, and have concluded that the analysis and the conclusions drawn are still valid.

NRPA has assessed the findings made by the operator and accepted the conclusion that these are valid.

Article 18: DESIGN AND CONSTRUCTION

All IFE's nuclear facilities were subject of the stress tests, but it was only identified need for measures at HBWR due to extreme events.

IFE found following accident scenarios most challenging for its facilities:

1. Complete station blackout when reactor running with full power
2. Design based accident with complete station blackout
3. Beyond design based accident with complete station blackout

Additionally, stress tests for the spent fuel pits have been conducted. No account for the initiation of a scenario has been considered in the analyses. Starting point of all the analyses is taken as the loss of external power supply, extending it to uninterrupted power supplies / batteries.

In a scenario when operating at full power, experiencing a blackout and loss of all safety systems, the analysis identified the need of forced cooling of some test fuel elements. As a part of the experimental program, these elements are equipped with a system for forced cooling of the fuel, a system that would malfunction in a blackout situation. This could lead to overheating of the fuel. A new system of additional cooling by natural convection in an emergency situation has thus been installed for these fuel elements during spring 2012.

The freshly unloaded spent fuel from the HBWR reactor is stored in fuel pits in the reactor hall. The pipe inlets and outlets are at the top of the pits. In a hypothetical station blackout scenario for the fuel pit containing full core loading, if a rupture occurs in the inlet water pipe the spent fuel may be completely uncovered within 7.5 hours. However, the heat generation from the fuel normally stored in the pit is about 30% of a full core loading of spent fuel. The calculations show that the cladding temperature will not be high enough to cause oxidation and hydrogen production. In order to avoid such situation a redundant pipe line has been installed and connected to the inlet of fuel pit pond.

NRPA has assessed and approved the analysis and proposed actions made by the operator.. NRPA also followed up these measures during inspections in order to assure the functioning of the above mentioned adopted measures.

Article 19: OPERATION

The operation of the two research reactors is limited to the time needed for performance of the research activities.

All experience gained from the regular operation and from incidents is fed back into the operation regime and relevant information from this is contained in the Safety Analysis Reports which form the basis for the licensing of the reactors. IFE updates the management system based on operational experience both regularly and as feedback from incidents. This updating is closely supervised by NRPA.

IFE participates in international forums like European Atomic Energy Society where operating experiences from research reactors are exchanged. Norway also participates in the Incident Reporting System for Research Reactors, IRSRR.

CONCLUSION

Norway is committed to be in compliance with the obligations according to the Convention on Nuclear Safety and are working intensively to upgrade the safety and the safety culture, inter alia through an intensified surveillance and inspection regime of the Norwegian research reactors.

The question of the organisation of the regulatory body is pending.