INDEPENDENT, STANDALONE OPERATION OF INTERIM SPENT FUEL STORAGE FACILITIES

P. DYCK
Nuclear Consultant
Forchheim, Germany
Email: dyck.fo@t-online.de

Working Group Standalone Operation of Interim Spent Fuel Storage Facilities,
Part of VGB Working Group Cask Handling and Prepositioning
VGB
Essen, Germany

Abstract

Interim away from reactor (AFR) storage facilities may be located at the reactor site using the complete infrastructure and personnel of the nuclear power plant for their operation or at a separate site using their own infrastructure as a standalone and independent facility. With the final shutdown and decommissioning of the nuclear power plants is this infrastructure for facilities at the reactor site no longer available. It becomes necessary to install a separate infrastructure and a separate team for the facility operation to become a standalone and independent facility. This paper deals with AFR storage facilities without own infrastructure and gives an overview as a checklist on the necessary considerations to become a standalone and independent storage facility.

1. INTRODUCTION

Water pools serve for storage of spent nuclear fuel assemblies immediately after their discharge from reactors at the nuclear power plants and for their cooling down for some period of time. These water pools are integrated in the plant design. Therefore at reactor storage (AR storage) is part of the plant operation.

The growing inventory of spent fuel in Member States, the lack of reprocessing capacities, the decisions of different countries not to use reprocessing, the lack of final repositories, the limited storage capacity in the reactor pools, and the wait and see policy in many countries made the construction of AFR interim spent fuel storage facilities necessary. The technology for AFR storage of spent fuel may be a wet or dry one. There are two types of interim AFR storage facilities. Many AFR spent fuel storage facilities are located at the reactor site using the complete infrastructure and personnel of the nuclear power plant for their operation. There exist also AFR spent fuel storage facilities at separate sites with their own infrastructure operating as a standalone and independent facility.

For a long period, wet storage of spent fuel using water pools was the predominant storage method. However, water pool storage requires active process systems to ensure satisfactory performance. Continuous attention is necessary to preserve water purity, excluding microbial (algae) growth and controlling the introduction of aggressive ions such as chlorides. Because of the large inventory of radio-nuclides under a relatively vulnerable protection against external hazards (such as earthquake, tornado, flooding, aircraft crash, etc.), in wet storage leads to safety, economical, and safeguards issues.

Dry storage technologies have become a mature international solution. A wide range of different technologies for the growing need of AFR storage was established in many countries. Dry storage technologies include casks, silos or concrete modules and vault technologies.

Many of these AFR storage facilities are located at the licensed reactor site using the same infrastructure and personnel as the nuclear power plant. With the shut down and decommissioning of the NPPs it becomes necessary to have an infrastructure of their own and a separate team for the facility operation.

The following checklist shall give an overview on necessary measures for a standalone and independent operation. The amount of necessary measures depends on the storage technology and the requirements of the respective licensing authority as well as specific regulations of the different countries.

2. CHECKLIST FOR A STANDALONE SPENT FUEL STORAGE FACILITY – GENERAL SUBJECTS

2.1 Documentation

In the first place it is necessary to set up a special documentation, identifying the storage facility, which kind of facility (wet or dry) and the licensed storage inventory (maximum capacity) as well as the currently used or still available storage capacity. The documentation has to show the licensed fuel types and if applicable the licensed types of casks, containers, silos or vaults.
With regard to the licensed inventory the generic information is necessary.
This information should include:

— Licensed content;
— Storage medium (air, water, inert gas, other);
— Temperature of the assemblies in storage and variation, if any;
— Transient or abnormal events, and their duration and consequences, if any.

Specific information for wet storage facilities:

— General physical and chemical characteristics;
— Pool temperature, pH, Cl — content, and other relevant parameters;
— Storage pool chemistry control such as chemical agents added to reduce biological growth of the pool water;
— Maintenance of the clarity of the pool water.

The operation of a standalone interim spent fuel storage facility involves a wide range of activities and necessary measures. Most of the activities have to be performed by own personnel. A part may be covered by external services.

2.2. Personnel

The operation team of the facility has to cover the following activities:

— Overall facility management;
— Receiving, handling, storage of spent fuel;
— Monitoring and environmental protection;
— Quality assurance;
— Information and data management;
— Safeguarding;
— Facility protection;
— Maintenance.

It is necessary to set up an organisation, covering all necessary functions and responsibilities for the operation of an AFR spent fuel storage facility.

3. CHECKLIST FOR DRY STORAGE FACILITIES

3.1. Buildings and Facilities

The necessary buildings depend very much on the storage technology, the site, and the environment.

— Storage building for dry storage, concrete vaults or storage pad;

— Guard house and entry control;
— Office building;
— Workshop;
— Transport routes;
— Fence and monitoring for physical protection.

3.2. Blectric Systems

The minimum of necessary electric systems as listed below.

— Electrical power supply;
— Electric lighting;
— Electric grounding and lightening protection.

For dry storage uninterrupted power supply is not necessary.

3.3. Instrumentation and Control

The amount of control technology depends very much on the authority requirements in the different countries.

— Communication system;
— Cask monitoring;
— Radiation monitoring;
— Alert systems;
— Data processing.

3.4. Water Supply and Removal

Even dry storage needs water supply and water removal.

— Drinking water;
— Water for fire protection;
— Sanitary waste water;
— Rain water removal;
— Water monitoring.

3.5. Radiation Protection

Radiation protection is a very important task in all nuclear facilities.

— Personal dosimetry;
— Contamination monitoring;
— Monitoring of the surroundings;
— Removal of radioactive residuals and waste.

3.6. Safeguards

The amount of spent fuel inventory in storage facilities and the significant amount of nuclear materials in spent fuel storage require IAEA safeguard controls. The objective of safeguards is the timely detection of

diversion of nuclear material for non-declared purposes by early detection. Safeguards inspection activities include:

— Design information provision and verification;
— Arrangements and procedures for material transfer;
— Material balance reporting;
— Maintenance of records and reports.

3.7. Physical Protection

Physical protection has to deter unauthorized movement and misuse of spent fuel and sabotage against the facility. It is an important part of national legal and regulatory framework for nuclear facilities and an important system in the AFR storage.

Physical protection includes not only a mixture of hardware and designated features to minimize such possibilities but also various administrative controls in the facility such as onsite security staff and security procedures.

— Security service;
— Facility monitoring;
— Additional measures according the competent authority.

3.8. Fire Protection

There is only very limited amount of burnable material in a dry storage facility.

— Fire protection by construction;
— Fire detection;
— Automatic fire alarm system.

3.9. Quality Control

All activities in a storage facility have to be performed according to the quality management system.

— Quality management system;
— Quality surveillance;
— Documentation and registration.

3.10. Maintenance

There are only a few systems and components in a dry storage facility needing maintenance and repair. Ageing management is the most important task.

— Maintenance and repair of systems and components;
— Periodic inspections;
— Ageing management.

3.11. General Services

The operation of a storage facility needs a bunch of general services. Most of them should be available inside the facility.

— General administration;
— First aid;
— Control system;
— Logistics;
— Social rooms;
— Sanitation;
— Locker room;
— Lavatories;
— Road service;
— Winter service.

3.12. Other Services

Several other services can be provided from outside of the facility except for radiation and safety.

— Training to maintain technical qualification;
— Emergency management;
— Commercial service;
— Legal service;
— Project management;
— Radioprotection officer;
— Safety officer;
— Dangerous goods safety advisor;
— Licensing;
— Insurance;
— Reporting system.

4. CHECKLIST FOR WET STORAGE FACILITIES

Most of the measures for dry storage facilities apply for wet storage too, however, wet storage AFR facilities need several specific measures listed below.

4.1. Buildings and Facilities

— Building for wet storage pools;
— Buildings for emergency power supply;
— Building for water purification and waste management.

4.2. Electric Systems

— Emergency power supply;
— Battery systems for uninterrupted power supply.

4.3. Instrumentation and Control

— Pool water monitoring for temperature and radioactivity
— Water chemistry
— Pool leakage detection

4.4. Technical Equipment

Wet storage facilities need active process systems and continuous attention to preserve water purity, temperature limits, and low radioactivity in the water and in the air.

— Cask cooling system;
— Cask loading and unloading system;
— Pool cooling system (pumps and heat exchangers);
— Water cleanup system;
— Radioactivity control;
— Air filter systems;
— Waste treatment;
— Laboratory.

5. CONCLUSION

With the shut down and decommissioning of the NPPs it becomes necessary that interim AFR storage facilities located at the reactor site have an infrastructure of their own and a separate team for the facility operation. The evaluation of the necessary measures has to be done carefully looking at all the details.

REFERENCES

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, Selection of Away-From-Reactor Facilities for Spent Fuel Storage, IAEA-TECDOC-1558, IAEA, Vienna (2007).
[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Storage of Spent Nuclear Fuel, IAEA-SSG-15, IAEA, Vienna (2012).