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SAFETY MANAGEMENT ON NUCLEAR POWER PLANT

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ABSTRACT

Requirement of law and execution of various strategies and practices by association to diminish mishaps at working environment is a continuum which has brought about new ways. The outcome showed that a sufficient improvement in wellbeing execution is conceivable with this methodology like Dock safety, stack safety, Manual material handling, rack safety, PIT and trolley handling, Rigging storage cage and Corona virus rules. Behaviour Based Safety (BBS) study is a cycle that makes a wellbeing organization among the executives and workers that persistently zeros in individuals' considerations and activities on theirs, and others, day by day security practices.

Keywords: Stack safety, Nuclear Power Plants and hazardous.

1. INTRODUCTION

The first and mandatory requirement to authorize regular operation of any industrial plant of the Department of Atomic Energy is a safety report tobe prepared and submitted by the unit to the Atomic Energy Regulatory Board seeking authorisation. The appropriate Project Safety Review Committee (PSRC) and the Advisory Committee for Project Safety Review (ACPSR) constituted for the purpose by AERB then carry out a safety review of the project. AERB considers the proposal for authorisation after the review is complete and the project authorities implement the recommendations of these committees. Therefore a need was felt for preparing a safety report in standardised format applicable for all projects. In 1990, AERB prepared a standard format for the first time viz. 'Safety Report Format for Industrial Plants other than Nuclear Power Plants' (AERB/M/ISD-1). Since then all new projects adhere to this format for their Safety Reports. Over the years considerable experience has been gainedin authorising nuclear fuel facilities. The time is now appropriate to update the guide/format for safety reports in the light of experience gained. This revised guide/format should be followed in the preparation of safety reports in future.

The Ministry of Environment and Forest has formulated rules for handling and storage of hazardous chemicals likely to affect the environment around such activities. These rules are called "Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989". These were last amended in 2000 and apply to an industrial activity or storage involving hazardous chemicals. The chemicals are classified into three categories. Correspondingly, three levels of controls are prescribed. Under high level requirements, 27 chemicals and 3 classes of compounds are included. They are potentially more hazardous and the threshold limits are specified. High level requirements also call for the preparation of a safety report. While preparing the report it is to be ensured that the requirement of stipulations in any other relevant codes/standards of statutory nature shall also be satisfied.

2. OBJECTIVES

Safety report is a document prepared by project authorities (applicant) and submitted to AERB. These guidelines aim at apprising the project authorities, the detail, furnished in the safety report. This information will enable AERB and its committees to assess whether adequate arrangements have been made for safe operation and whether control measures are in place to mitigate the consequences of major accidents. The safety report should identify the type, the relative likelihood and the consequences of major accidents. The safety report will demonstrate that accident potentials of activities have been identified and control measures incorporated.

3. SCOPE

These guidelines are applicable to all industrial plants in the Department of Atomic Energy other than nuclear power plants for assessment of proposal for siting, commissioning and operation. The topics required to be covered are site conditions, process details, quality assurance, hazardous chemicals involved, hazard control mechanism, radiation hazard control, waste management, safety system, safety and operational analysis, organisational system, inclusion of safety training and crisis management, mitigation of accident and medical facilities etc. In view of wide variation in both the size and type of plants, applicability of various aspects brought out in this document should be checked before preparation of the safety report. Sections 2 to 15 discuss these topics in a broad and general manner. The details to be furnished in the safety report are covered in Appendix-I.

4. SITE CONDITIONS

Siting of a plant requires careful evaluation of various factors such as raw material availability, source of water, power, effect on human settlement, meteorological conditions, environmental impacts (i.e. effects on flora and fauna) etc.. Information on topographical and geological aspects is also needed prior to installing the plant, as it will help in designing the plant from safety viewpoint. Information on roadways, the nearest railhead, and airport helps in assessing plant accessibility. The land acquired shall be adequate for storing/treatment of wastes generated from plant operation.

5. PROCESS

Process description including type of reactions, critical process parameters relevant to safe operation, energy, material and water balance are to be given in the report. Details on layout of the equipment, and power supply systems should also be given. The layout of equipment containing hazardous chemicals and power supply system is critical and needs to be designed from the stand point of hazards arising out of any unusual occurrences.

6. QUALITY ASSURANCE

Quality assurance programme at each stage starting from design, fabrication till the product/waste is to be brought out, the standard used and the deviation from standard, need to be mentioned.

7. HAZARDOUS CHEMICALS

Handling of hazardous chemicals requires special precautions. Storage of hazardous chemicals is required to be designed strictly as per the relevant code allowing adequate margin for safety. The quantity of hazardous chemicals to be stored at a time and the distance to be maintained between two storage tanks should be taken into consideration. Pressure relief system, draining arrangement, spare storage capacity and alarm system are to be provided. Statutory provisions under the Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 should be followed and the license for storing and using should be obtained fromthe competent authority.

8. HAZARD CONTROL MECHANISM

The hazards of chemicals generated and present in a working environment in the form of dust, fumes, vapours and sprays and the engineering measures taken to control them need to be described. Preventive measures to avoid contamination of working personnel by ingestion, inhalation or by skin contact are to be mentioned. Mechanical means for spillage control of hazardous chemicals need to be provided.

9. RADIATION HAZARD CONTROL

The hazards of ionising radiation from radioactive substances are to be described and the radiation hazard control should conform to the Radiation Protection Rules, 1971. Zoning system for contamination control, access control for radiation exposure of personnel, radiation levels, shielding provided for areas of continuous or limited occupancy, if any, are to be mentioned. Design of ventilation system involving number of air changes per hour to control airborne contamination should be indicated. Provisions for decontamination of equipment/areas are to be included. Handling of radioactive materials is to be covered. Safety codes/guides published in this regard by AERB should be referred for radiological protection during handling of radioactive material.

10. WASTE MANAGEMENT

The acts and rules applicable to management of waste are: The Water (Prevention and Control of Pollution) Act, 1974, The Air (Prevention and Control of Pollution) Act, 1981, The Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987 and The Hazardous Waste (Management and Handling) Rules, 1989. The waste management system shall conform to these acts and rules. Three classes of waste according to their physical states are:

LIQUID EFFLUENTS

Soil permeability should be studied before discharging the effluents into holding tanks or impoundment and steps taken to prevent percolation and ground water contamination;

Deep well burial of toxic effluents/radioactive components can result in resurfacing and ground water contamination;

In all cases efforts should be made for reuse of water; and Components, either radioactive or toxic or harmful to plant, animal or ecosystem, should be measured as mentioned in the above rules before discharging to public domain.

GASEOUS EMISSIONS

Emission levels of chemical/radioactive pollutants from different stacks should conform to pollution control standards; and Proper stack height should be provided for appropriate level of dispersion of pollutants over a wider area to minimise the effectof pollution.

SOLID WASTES

The site for waste disposal should be evaluated to verifypermeability to avoid contaminants percolating to ground water or river/lake; and Containment in which radioactive/toxic wastes are disposed off should be appropriate as per the Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987/Hazardous Wastes (Management and Handling) Rules, 1989 respectively.

DECOMMISSIONING

Design should ensure that plant and equipment are amenable for easy decontamination. The site for disposal of waste generated after decommissioning should be planned during installation considering the life of the plant and the maximum amount of waste expected. The civil structural arrangement for constructing the site should ensure avoidance of (a) contamination of nearby water source, and (b) permeability of the radioactive substance to soil affecting nearby vegetation (Ref: AERB/SM/Decom - Safety Manual for Decommissioning of Nuclear Facilities).

SAFETY SYSTEM

The primary objective of safety system is to ensure safe operation of the equipment, within designed parameters like pressure, temperature, gas/liquid flow etc. and hence of preventing fire, explosion, release of toxic/radioactive materials or criticality which may lead to loss of material and property. This is achieved bya built-in safety system incorporated in the design to ensure that operating parameters are not exceeded beyond safety limits through interlocks which control process parameters and alert operating staff by audio-visual signals. Action such as switching off power supply, cutting off feed and starting of water sprinklersystem etc. should be described.

SAFETY ANALYSIS

Safety of the proposed plant needs to be analysed at the design stage itself and the major steps involve the qualitative identification of hazards in the plants and consequence analysis risk, the details of which are to be furnished.

SAFETY ORGANISATION

To ensure better health and safety in an organisation, safety consciousness and the priority for safety should be activated by the senior most executive and the first step to achieve this is the formation of a structured safety organisation and various safety committees. The head of the safety organisation should report to the senior-most executive of the organisation and his duties will be to advise and assist the head of the organisation in the fulfilment of his safety obligations. The main functions of safety officer and safety committees are identifying unsafe conditions and practices and initiating action to rectify them, and ensuring adherence to safe practices.

STATUTORY REQUIREMENTS IN THE PLANT

Under various sections of the Factories Act, 1948 and the Atomic Energy (Factories) Rules, 1996 competent persons and safety officers respectively are required to be appointed to carry out certain specific tasks and duties as mentioned in the above statutes. The Radiation Protection Rules, 1971 also call for the appointment of a Radiological Safety Officer in plants where radioactive materials or radiation generating equipment are stored, handled and used.

MITIGATION OF MAJOR ACCIDENT

Plans for on-site emergency and off-site emergency need to be prepared to tackle any unusual situation in an organised/systematic way. The responsibility for preparation of site emergency plan rests with the occupier and it is to be prepared in accordance with the AERB safety guidelines, AERB/SG/EP-3 and AERB/SG/EP- 4. Reportable accidents and unusual occurrences are to be investigated for remedial measures to avoid recurrence and should be reported to the appropriate authorities in prescribed forms designated for the purpose. Fire-fighting capability is one of the key factors for tackling fire emergency in a plant and this requires adequate manpower and the necessary fire-fighting equipment. Depending on potential hazards in the plant, fire detection and fire suppression systems are to be installed.

MEDICAL FACILITIES

One of the requirements for ensuring safety is to provide medical facilities for employees in case of an accident or accidental release of toxic chemicals. There should be provision to extend preliminary treatment, including antidotes to affected persons. It is desirable that information on services of first-aid centres, hospitals (within 5 km radius) with special facilities to treat injured persons is readily available. This information should be available and maintained properly in the control room. Provision of well-equipped ambulance and its proper maintenance will avoid delay in transferring patients/injured to the place of treatment. Training and refresher training in first-aid should be imparted on a regular basis to plant employees to avail the first-aid service in an emergency. Periodic medical examination to the occupational workers as per the Radiation Protection Rules, 1971, the Atomic Energy (Working of Mines, Minerals & Handling of Prescribed Substance) Rules, 1984 and the Atomic Energy (Factories) Rules, 1996 needs to be arranged.

11. **DETAILS OF TOPICS TO BE FURNISHED IN A SAFETY REPORT**

This Appendix provides guidance to project authorities to prepare a safety evaluation report such that the information to be provided on each of the topics listed in these guidelines is sufficiently detailed and brings out hazards and measures that need to be taken for their control. Queries are not to be dismissed with short answers. Where any item of the guidelines is not applicable to a particular project, the same should be stated in the report, along with reasons as to why it is inapplicable. While every topic listed in the guidelines is to be covered in the report any item not listed but important to fully explain the safety implications is required to be included in the safety report. For a plant consisting of a number of systems, where the nature of the hazards is different, the report should contain separate discussions on each.

SITE CONDITIONS

Site description, land use and population density around the plant: (Attach a map showing locations and surrounding areas up to 5 km radius).

Names of villages, population data, educational institutions, hospitals, police station and primary health centres within 1 km,2 km and 5 km radii of the plant.

Major industries/storage within 5 km radius:

Sources of water, power,

Airport nearby, if any, and

Site map indicating railway station, highway and district level roads, approaches and district headquarters.

Geological, topographical and meteorological aspects:

Water table, existence of river, sea, lake - with distance from the site,

Geological conditions,

Ground water sources, and temperature (maximum and minimum), temperature inversions, humidity, rainfall (maximum and minimum), maximum flood levelsand frequency of occurrence for a period of at least last five years.

Wind speed, direction and wind rose.

Seismic conditions:

Details of all earthquakes in the area:

Zones as per Indian Standard (IS: 1893)"g" factor taken for seismic design,

Active fault line, if any, within the vicinity, and type of soil, liquefaction potential.

PROCESS

Basic principle of the process.

Process description with energy, material and water balance,highlighting hazardous reactions and chemicals involved, if any: description of the process with a flow chart/P&I diagram, codes/standards used for plant design including materialselection criteria,

Critical process parameters relevant to safety and safety features incorporated, and details of instrumentation and control system.

12. HAZARD CONTROL MECHANISM

Identification of hazards such as dust, mist, vapour, spray, skin contact/clothing contact of toxic/harmful chemicals and other process streams.

Any engineered system to be provided to control such hazards orother measures to be taken for control.

Likely spillage/leakage of process streams/process chemicals in the working areas and measures of control.

Housekeeping system that will be followed, to keep working areas clean and free of any leakage/spillage, for example, use of vacuum cleaning equipment, system of sumping and pumping to process. etc..

Fire hazard control - solvents, volatiles, flammables.

13. RADIATION HAZARD CONTROL

Radioactive material handled: Forms (sealed or unsealed), quantities, activity and nature of radiation.

Zoning system for contamination control, access control for limiting radiation exposure of personnel, radiation levels, shielding provided for areas of continuous or limited occupancy, if any.

Design of ventilation system including number of air changes perhour to control airborne contamination for active and inactive areas.

Design provisions for decontamination of equipment, areas and personnel.

Design provisions for safe handling of radioactive materials transport.

Health Physics Instrumentation: installed monitors and alarm systems, portable radiation survey instruments, and health physics laboratory instruments,

Provisions made for area and air monitoring and personnelmonitoring – external and internal

and maintaining records.

Radiation protection standards and procedures.

Health Physics Unit – staff strength and training in radiation safety.

Radiation emergency action measures taken for control of criticality.

14. SAFETY ORGANISATION

Organisational chart: in-house organisational relationships established for design and construction, review and quality assurance functions, safety organisation at the corporate level and plant level, technical staff for operation and maintenance of the plant, and working inter-relationships with suppliers, contractors and statutory/ regulatory bodies.

Implementation of plant safety as mentioned in relevant Acts and Rules: corporate functions, responsibilities and authorities, adequacy in plant engineering and design, quality assurance, testing, operation and other applicable activities, safety review and assessment process - safety committees, and authorisation of Competent Persons.

Implementation of safety procedures: preparing, reviewing, approving and executing all procedures, safety work permit procedure, and procurement of personnel protective equipment and maintainingstock.

Maintenance and inspection schedules: preventive maintenance for equipment – load testing of cranes, hydrotest, inspection of equipment (inspection of pressure vessels) etc., and maintenance of document regarding inspection.

Training of personnel: training programme including scope of training in plant operations,safety procedures (chemical and radiological) and industrial safety, methods of dealing with process malfunctions, safety systems,emergency procedures, etc., retraining of personnel and identification of organisation responsiblefor training and retraining, and procedures for qualification of operating and maintenance staff.

15. THRESHOLD QUANTITIES OF CHEMICALS

(As given in the Manufacture, Storage and Import of Hazardous Chemicals Rules,1989 amended up to 2000)

Chemical	Threshold Quantities (tonne)
Ammonia	500
Chlorine	25
Hydrogen fluoride	50
Hydrogen sulphide	50
Hydrogen	50
Liquefied oxygen	200

Note: Substances most commonly used in DAE installations are given above. For other substances not listed here, refer the Manufacture, Storage and Import of Hazardous Chemicals (Amendment) Rules, 2000.

16. TYPICAL DETAILS TO BE FURNISHED IN THE ON-SITEEMERGENCY PLAN

Name and address of the person furnishing the information.

Key personnel of the organisation and responsibilities assigned to themin case of an emergency.

Outside organisations if involved in assisting during on-site emergency:

type of accidents, and responsibility assigned.

Details of liaison arrangement between the organisations.

Information on the preliminary hazard analysis:

type of accidents,

system elements or events that can lead to a major accident,

hazards, and safety-related components.

Details about the site:

location of dangerous substances,
seat of key personnel, and
emergency control room.

Description of hazardous chemicals at plant site:

chemicals (Quantities and toxicological data),
transformation, if any, which could occur, and
purity of hazardous chemicals.

Likely dangers to the plant.

17. REFERENCES

1. The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989.
2. The Water (Prevention and Control of Pollution) Act, 1974
3. The Air (Prevention and Control of Pollution) Act, 1981
4. The Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987
5. The Hazardous Waste (Management and Handling) Rules, 1989
6. The Radiation Protection Rules, 1971
7. The Atomic Energy (Working of Mines Minerals and Handling of Prescribed Substances) Rules, 1984
8. The Factories Act, 1948
9. The Atomic Energy (Factories) Rules, 1996
10. ATOMIC ENERGY REGULATORY BOARD, Safety Manual, "Radiation Protection for Nuclear Facilities"- Revision 3, 1996