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In the event of any differences in interpretation of this guide, the Finnish version shall take precedence over this translation.

RADIATION PROTECTION IN DESIGN OF NUCLEAR POWER PLANTS

CONTENTS

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1

GENERAL

The radiation doses of nuclear power plant personnel shall be kept as low as reasonably achievable, economic and social factors being taken into account. Besides individual doses, attention shall be paid to collective doses in order to keep the doses in conformity with the above-mentioned principle.

The collective dose of persons working at the plant should not exceed 5×10^{-3} manSv (0.5 manrem) for 1 installed MW of electric power per year. If this figure is exceeded, the licensee shall take actions to increase the effectiveness of radiation protection. The design and construction of a nuclear power plant shall be so realized that it is easy to reach values below this figure.

Accidents which involve the release of radioactive substances in large amounts inside the plant should be taken into consideration in the design phase so that doses even in situations of this kind remain below the dose limits. The dose limits are given in the Resolution (549/68) of the Ministry of Social Affairs and Health.

2

SCOPE

This guide does not give any unambiguous definitions of how the planning and implementation of nuclear power plant radiation protection shall be carried out, because this depends very much on such factors as the design of the plant type and the most important components. Instead this guide presents some objects that affect the radiation doses of the personnel and that shall therefore be taken into account in the design and construction of a nuclear power plant.

The guide presents a procedure, according to which the applicant shall show how the principles set forth in the guide will be taken or have been taken into account in the design, construction and start-up testing of the plant.

At a completed plant, the guide may also be applied to the planning of plant modifications affecting the radiation doses to the personnel.

The guide does not deal with the health physics programmes during the start-up testing or operation of the plant unit, which are treated in Guide YVL 7.9 "Healt Physics Programmes in Nuclear Power Plants, 21 April 1981".

3 OBJECTS REQUIRING CONSIDERATION OF RADIATION PROTECTION ASPECTS

3.1 Design organization

In the design phase of a nuclear power plant, the work of the contractors shall be guided so that the plant unit to be designed meets the objective of keeping radiation doses as low as reasonably achievable. This requires a sufficient amount of expertise in radiation protection in the design organization.

The implementation of safety-related objects that are planned shall be supervised.

In accordance with Guides YVL 1.1 "The Institute of Radiation Protection as the Supervising Authority of Nuclear Power Plants, 10 May 1976" and YVL 1.4 "Quality Assurance Programme for Nuclear Power Plants, 20 October 1976" the applicant shall submit both the applicant´s and the main contractor´s quality assurance programme to the Institute of Radiation Protection for approval. The quality assurance requirements and guidelines presented in Guide YVL 1.4 concerning structures, systems and components shall also be adhered to so that the radiation doses of the persons working at the nuclear power plant will be kept as low as reasonably achievable.

3.2 Layout of rooms and systems

The dose rate of external radiation and the risk of internal exposure in rooms where work may have to be done shall be maintained as low as reasonably achievable. The rooms shall be classified as early as in the design phase on the basis of radiation risks. The classification shall be in conformity with the access limitation practice to be adopted at the plant during operation.

If possible, systems containing radioactive gases or fluids should be so designed that they consist of few components. This in turn means that there will be fewer radiation sources and objects of work.

In layout of components, attention shall be paid to the testing, maintenance, inspections and repairs that the safety regulations, instructions for use, or the manufacturer´s maintenance instructions require.

Early information on periodic inspections, maintenance and repair measures, and objects needing adjustment is necesary to facilitate such a layout that the number of radiation emitting components in one room can be minimized. This makes it more easy to protect the object of work.

Enough room shall be reserved for maintenance and repair measures and periodic inspections to make the work easier and faster. The redundant parts of one system shall be properly placed in separate rooms.

The adjusting, measuring, control or auxiliary equipment needing maintenance or repair shall be detached from the component emitting radiation and placed in a separate room or in a protected area.

If the component to be repaired or maintained is located in a room with a very high radiation level, it should be possible to remove the component for repair to an area with a low radiation level, or the component shall be so designed that it is easy and quick to replace.

Collection, monitoring, sorting and storage facilities shall be reserved for the solid waste generated in connection with repair and maintenance.

Room for an active workshop shall be reserved in the vicinity of the decontamination room at the plant. In the design of the workshop, also the repair and maintenance of electric motors and other electrical devices shall be taken into consideration.

Routes for periodic maintenance or inspections shall be planned so as to be unobstructed.

An effort shall be made to design personnel and material traffic so that it is flexible and fast in the controlled area. Transportation flow charts and miniature models should be used inthe design, where necessary, especially when designing the transportation of large components.

Arrangements concerning personnel traffic shall be dimensioned taking into account the great num-

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A4 75-2658 b/4

ber of temporary employees during outages. The prevention of traffic blocks is necessary for the effective execution of radiation protection measures. Attention shall especially be paid to the personnel inside the plant.

Corridors, staircases, steps and ladders shall be so dimensioned that, when necessary, a person in protective clothing can easily use them.

Areas with components containing active fluids shall be so designed that the floor channels and tilts can drain dimensioning basis leakages readily into a sump.

Floor channels can become sources of external radiation or air contamination. Therefore it should be possible to decontaminate or flush the channels. The protection of the channels shall also be possible, when necessary.

In case the sumps are clogged or their suction is insufficient, the floor drainage should not cause floods on the floors of other rooms.

Areas where removable radiation protection structures can be placed shall be marked with signs showing the highest possible loading.

Office and storage room shall be reserved for radiation protection. Especially there is a need for storages for radiation sources and portable radiation meters, storage for protective equipment, calibration room for meters and storage for supplies needed in emergency situations.

3.3 Arrangements concerning entering and leaving the controlled area

Access to the controlled area shall be controlled and restricted. Personnel traffic and the transport of radioactive substances and contamination shall be supervised on the boundary of the controlled area.

The rooms of the controlled area shall be easy to leave. The reliable isolation of rooms of the highest zone shall be possible.

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A decontamination room with emergency showers for persons, active laundry, storage for overalls and other protective equipment, and room for first aid measures shall be placed in the controlled area.

Room for measuring the contamination of persons and for dosimeters shall be reserved near the boundry of the controlled area. Background radiation must not disturb these functions.

The locker rooms, showers and toilets that are placed outside the controlled area shall be dimensioned taking into account the great number of workers during outages.

3.4 Radiation shields

In the design of radiation shields, the principle of optimization shall be followed, i.e. radiation doses shall be kept as low as reasonably achievable.

Known calculation methods shall be employed in the dimensioning of radiation shields.

In the design of radiation shields, precautions shall be taken against accident situations that involve the release of radioactive substances in great amounts into reactor water and inside the containment. Attention shall be paid to rooms where one must work or which may have to be visited during or after the accident, for instance, the main control room, rooms containing components of emergency cooling systems, sampling areas, laboratory and other places of action inside the plant or at the plant site.

The streaming of radiation and the penetrations and openings in the shields shall be taken into consideration in calculations. Where necessary, labyrinth structures may be utilized, but the transportation of components shall not be obstructed.

Objects of maintenance, repair, periodic inspection or calibration should not be located in the field of other radiation sources. This shall be prevented by carefully considered layout and shielding. Room shall be reserved for a comfortable working position near anticipated objects of work.

A4 81-1115/4

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If an object cannot be shielded from a radiation source in the same room by using permanent shields, enough room shall be reserved for temporary shields where necessary. They must be so designed that it won´t take much time to install of disassemble them. Any components that may obstruct the installation of the shields shall be easy to remove and re-install.

If need be, it shall be posible to shield piping emitting radiation , for instance, by using concrete troughs, which shall be taken into account in the dimensioning of structures.

The transport and storage of spent fuel and parts removed from the reactor core shall be given special emphasis in the design of shields.

If the control rod actuators cannot be placed anywhere else than in rooms exposed to radiation, their remote controls shall be located outside radiation protection walls.

3.5

Corrosion

Attention shall be paid to the choice of material to be used for the components of the primary coolant circuit which are in contact with coolant (piping, pumps, steam generators, heat exchangers, etc.). As regards activation products, especially nuclides ^{58}Co and ^{60}Co shall be avoided by using construction materials with low cobalt and nickel content. The hydrogen content of steel should also be low. The aim is to minimize corrosion. Decontamination of components shall also be taken into consideration when choosing construction materials.

For keeping corrosion low, there shall be facilities for the sampling, analysis and adjustment of coolant water chemistry.

In the design of the primary water clean-up system, the highest corrosion product content that can be regarded as dimensioning basis shall be taken into account. The system shall be able to function effectively in all operational situations or its function shall otherwise ensure sufficient clean-up.

Special attention shall be paid to the clean-up of condensate in boiling water reactors.

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To keep erosion low, one shall pay attention to the geometry of the piping and take care that no extraneous substances or objects are let into the cooling circuit (e.g. cleaning of sealing waters, lubricants).

An effort shall be made to prevent the sedimentation of crud[1]) by creating a laminar flow where possible, by using pipes with smooth and even inner surfaces and by avoiding holes and grooves which might gather crud.

Dead spots and sections that stop the fluid from flowing shall be avoided in pipe lines.

To remove deposits, systems and piping shall be provided with flushing facilities.

3.6 Decontamination

3.6.1 Decontamination of surfaces

The need for decontamination can be diminished in the design phase by paying attention to the prevention of leaks and by leading the deaeration and drainage lines as well as the overflow pipes of tanks into a closed system.

Floor and wall surfaces shall be smooth, they shall not contain pores, cracks or crevices, sharp angles or corners. The materials chosen for lining shall facilitate and withstand the planned decontamination measures.

The juncture of the walls and the floor shall be rounded, if necessary.

If the floor is lined with a plastic mat or a corresponding cover, the mat shall be extended on the walls over the height of the highest fluid level that can be regarded as a dimensioning basis.

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1) Crud means corrosion or erosion products or other solid substances that are generated chemically or physically on the boundary surfaces of fluid and the structure.

3.6.2 Decontamination of components

It shall be possible to decontaminate components requiring maintenance, adjustment or repair. Systems shall be provided with necessary flushing and decontamination facilities and a sufficient amount of connection pipes, through which one section of the piping, one valve, etc, can be flushed at a time for maintenance. The treatment of used decontamination and flushing liquids shall also be arranged.

The decontamination of steam generators shall be effective enough. It shall be possible to decontaminate the primary circuit, its various parts and the drainage system. Also the coolant treatment systems shall be provided with flushing and decontamination facilities.

It shall be possible to clean the bottom and walls of the fuel basin as well as the components that are used in the basins.

The following equipment should be provided for decontamination:

- basins where decontamination chemicals can be led to and where they can be removed from
- high pressure water jets, compressed air/water jets
- treatment system for used decontamination liquids
- compressed air - sand/glass ball cleaner
- aspirators
- decontamination room which shall be located near the active workshop. The room shall accomodate the biggest removable part of the plant that is to be decontaminated.

The transportation of highly-active components should take place through rooms with no contemporaneous personnel traffic.

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4. ITEMS TO BE CONSIDERED IN THE DESIGN OF COMPONENTS AND SYSTEMS

4.1

Fuel basins

Room shall be reserved for the fuel inspection equipment to be placed in the basins. The requirements of radiation protection shall be taken into account in the design of special tools needed in inspections. The clean-up system of the fuel basin shall circulate water all through the basin. Room shall be provided for leaking fuel bundles and they shall be so placed that they do not cause any unnecessary radiation exposure. The equipment used in fuel treatment must be so designed that the probabilities of treatment accidents are small and the possible consequences of little importance.

4.2

Control rod drives

The objects of inspection, repair and maintenance should be located in the easily accessible parts of the control rod drives with radiation levels as low as possible.

4.3

Steam generators

The plugging device of the heat exchanger tubes should be designed and tested before the commissioning of the plant.

The manhole shall be large enough so that a worker in protective clothing can easily move in and out. Passage and moving inside the steam generator shall be convenient.

4.4

Pumps

Pumps should be placed in easily accessible areas with a low radiation level. If need be, redundant pumps shall be placed separately in rooms protected against radiation.

The change of pumps shall be planned so that it is simple and quick. This can be achieved by choosing suitable connection pipes and by using standard joints.

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122691 STL - SF

To make the periodic inspections, maintenance and repair of the pumps more easy and quick, there shall be enough room to work around the object. The removal and re-fixing of heat insulation shall be easy. In the design phase, preparations shall be made for the use of remotely controlled inspection devices. Especially the maintenance facilities of the emergency cooling system pumps shall be given extra consideration.

The inspection of the pump seals shall be made easy, for instance by eliminating the need to disconnect the motor.

Seals and bearings shall be durable and their replacement shall be quick. To prevent leaks, hermetic pumps should be utilized. The deposition of radioactive substances on the seal surfaces or cavities can be diminished by flushing the pump seals. It should be possible to water the pump housing. Filling and changing holes for lubricating and cooling oil should be placed in a shielded room away from the pump emitting radiation.

4.5

Valves

Valves should be placed in easily accessible areas with a low radiation level.

The valves that are chosen shall require little maintenance. To make maintenance easier, the stems of the valves should be placed upwards, if possible. Formation of cavities and cracks shall be avoided in installation.

The objective of design should be the rapid detection of valve leaks.

Attention shall be paid to the corrosion properties and wearing of the valve seals and seal surfaces. It shall be possible to observe the condition of the seals with the help of leakage lines. The service life of the seals can be extended e.g. by a dual seat structure of the stem. The tightening of the inner seals of the dual seals in valves shall be easy. The disassembly and assembly of valves shall occur quickly and readily.

It shall be possible to adjust safety valves without dismounting part of the valve.

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Telephone
659588

Telex
122691 STL SF

A4 75-2658 b/4

If a valve cannot be placed in a low-activity area, it shall as a rule be driven by a motor, or manual operation shall be placed outside the radiation shield.

In case of accidents, it shall be possible to close the important shut-off valves of systems outside radiation shields.

4.6

Pipelines

Pipelines containing active water should be as short as possible in rooms where work must be done.

In regard to radiation protection, it is important that the location of pipelines is planned. If possible, the planning should be completed before the construction of the plant is begun. Miniature models, for example, may be useful in the planning.

Piping containing radioactive fluids shall be separated from clean piping and placed as far from objects requiring maintenance as possible. Active pipes shall be designed to last for the whole service life of the plant without any repairs or modifications.

Enough room shall be left between the pipelines and the walls to make periodic inspections and potential repairs and modifications easier.

Pipelines shall, if possible, decline to the direction of the flow. Line parts with no flow shall be avoided.

Drainage facilities shall be arranged in the lowest parts of the pipelines. Drain water shall be led to a sump or into a closed system. Pipelines shall be so designed that the need for deaeration and drainage lines will be as small as possible. Hence the number of maintenance and operational objects can be diminished.

Downward legs in which there is normally no flow should be avoided in pipelines. Formation of grooves and cavities on the inside of pipelines shall be avoided by proper design and fabrication of parts and joints.

Pipelines leading to an object needing maintenance (e.g. lines on the suction and pressure sides of a pump) should be installed from the same direction to make shielding easier.

Redundant lines shall be placed in separate rooms.

Quickly changeable pipes and standard connections shall be used in the design when necessary.

Pipelines shall be so designed that they contain as few welded joints to be periodically inspected as possible.

Piping that contains radioactive fluids shall be provided with flushing and decontamination facilities.

The flushing facilities of pipelines shall be taken into account in view of possible accidents in which great amounts of radioactive substances are released into reactor water and into the containment.

Sampling pipes shall be led into areas with a low radiation level. Sample lines shall be concentrated in air conditioned and drained cubicles. The diameter of the sample lines shall be sufficient to prevent clogging.

It shall be possible to take samples of reactor water and of the gas in the containment during accidents without exceeding dose limits.

Pipelines shall be marked clearly and unambiguously.

4.7 Heat insulations

It shall possible to quickly remove and re-install the heat insulations of systems and pipelines around objects of maintenance and periodic inspections. The design of heat insulators shall be purposeful so that there is as little air contamination generated during the removal of the insulators as possible.

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4.8

Leakage collection, drainage, and water treatment

The amount of leaking waters shall be minimized.

Waste water should be classified according to its origin to make further treatment easier, for instance, leak water containing boron should be separated from other waters.

The sump system shall be extended to all rooms in which there are systems containing radioactive fluids, with the exception of rooms which do not allow the removal of water by virtue of the operation of the reactor emergency systems.

Crystallisation and deposition in tanks shall be prevented by making the bottoms of the tanks slant towards the outlet, by constructing circulation lines to homogenize the contents and by designing a spray system that can mix the contents with the help of a gas-water mixture.

The ventilation or airing of tanks shall be arranged as part of the gas treatment system or the active ventilation system. The water locks of the tanks shall be reliable and uncontrolled leaking of overflow water into rooms shall be prevented.

It shall be possible to carry out reverse flow flushing, washing, regeneration, and change of mass for the filters by remote control.

4.9

Treatment of resins and concentrates

Deposition of resins and evaporization concentrates in the piping and in components of the waste system shall be reduced:

- by minimizing the lenght of pipelines
- by using pipes with large diameters
- by minimizing the number of pipe joints and connectors
- by avoiding pipe sections that can gather solid materials
- by utilizing gravity where possible to transport fluids in pipelines

A4 81-1115/4

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- by minimizing the number of flow-obstructing components
- by making the bottoms of the tanks slant towards the outlet
- by installing circulation lines for mixing the contents of the tank

Need for maintenance can be reduced

- by using valves constructed to prevent resins and evaporization concentrates from depositing and obstructing stem movements
- by choosing valves with as few cavities as possible
- by providing the tanks with reserve connection pipes to make the removal of deposits easier

Bends in the pipes should be avoided. The radius of a bend should be fairly large. T-pieces should be avoided. In case they have to be used, normal flow should pass through the straight section and the leg should be placed horizontally or preferably above.

The insides of the pipes and the pipe joints should be smooth. Butt welds should be used in joints.

Clogging of the pipes shall be taken into account and the reverse flow flushing of the lines with water/compressed air mixture shall be possible. Also resins can be made more easily movable with the same method.

Crystallisation and deposition in tanks can be prevented by making the bottoms of the tanks slant adequately towards the outlet and by designing a mixing system to be placed in the tank. The gas space in the tanks shall be aired into the treatment system for active gases.

The overflow lines of the tanks should be provided with sieves that prevent the escape of resins and concentrates from the tanks. It shall be possible to flush the sieves.

It shall be possible to perform solidification and storage of resins and concentrates by remote control with shielding. The solidification plant and the storage should be located as near the treatment facilities of liquid waste as possible.

A4 75-2558 b/4
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4.10

Ventilation and gas treatment systems

One objective in designing ventilation systems is to distribute clean air into rooms which are visited at least once a year. Air shall normally be so clean that no respirators are needed.

Operations in rooms, for instance, decontamination and treatment of solid wastes, shall be so planned that they do not cause air contamination.

The direction of pressure differences in ventilation shall be from low-activity areas to more active areas. The control of significant pressure differences shall be so designed that it is fast and easy.

The ventilation system should be of help in determining in which room a contamination originates. This can be accomplished, for instance, by providing the outlet channels of ventilation with proper aerosol sampling points.

The ventilation and gas treatment systems gather radioactive substances which may obstruct maintenance and repair, testing, decontamination or replacement of components. Objects shall be so designed that they are easily accessible. Room shall be reserved for working. Redundant components shall be placed in separate rooms to make radiation shielding easier.

The ventilation lines shall be provided with arrangements for necesary work-specific suction facilities. Separate movable air cleaners shall be reserved for the removal of air contamination in places of work. Arrangements and equipment are needed, for instance, in the machining of contaminated surfaces.

Fume hoods shall be used to ventilate sampling places.

The exchange of filters of the ventilation and gas treatment systems and their testing shall be so designed that they can be performed practically and safely.

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4.11

Electrical systems

Active areas shall be avoided in the placing of cables. Couplings and joints should be located in rooms where working is convenient and the radiation level low.

4.12

Instrumentation, adjustment and control

In the design phase, attention should be paid to the periodic inspections, maintenance and calibrations of instrumentation so that they can be performed in rooms with a low radiation level. Indicators and controls of instruments shall also be placed in accessible rooms.

If a component cannot be placed in an area with a low radiation level, it shall be possible to perform repairs by replacing parts.

Transmitters should be so chosen that they do not collect radioactive substances.

4.13

Radiation measurements and dose monitoring

Dose rate of external radiation, surface and air contamination, activities in processes, releases, individual contamination and radiation doses shall be measured at nuclear power plants.

Stationary meters that are used for the measurement of the dose rate of external radiation shall be placed in areas where sudden rise of the radiation level can be anticipated. The equipment shall be provided with local alarm and display. The display shall be clear and simple to read. If the area is not accessible, the display shall be placed outside the area in an accessible room. The registration of the measurement results shall be possible, when deemed necessary.

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Processes dealing with radioactive substances shall be provided with a sufficient number of activity measurements, which are used when making an attempt to asses the dose rates induced by parts of the process in question in potential objects of work.

The display and alarms of process meters shall be led to the main control room. The registration of the measurements shall be possible, when deemed necessary.

The measuring equipment for body and clothing shall be located on the boundary of the controlled area, in an area with low radiation background.

The periodic inspections of stationary radiation monitoring equipment shall be so designed that they can be carried out in rooms with low radiation level.

Stationary radiation monitoring equipment shall include a circuit which gives an alarm of a component fault.

Dose monitoring shall be so arranged that the requirements set forth in Guide YVL 7.10 "Individual Monitoring and Reporting of Results, 8 November 1978" can be fulfilled.

4.14

Other factors

It is recommended that the installation and dismounting of components be videotaped in order to make the planning of the work easier.

The location of components in closed rooms should be photographed in order to save time when the objects of work are searched for in connection with the work.

Special tools shall be developed for the removal and installation of the reactor vessel head an internals to make work faster. The repair and inspection of steam generators shall be so designed that they can be carried out rapidly with special tools.

Lighting and proper air temperature at working places shall be taken into account as factors speeding up the work.

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The loudspeaker system and the telephone system shall reach all rooms. Noise and potential protective equipment shall be taken into account in the design.

The installation of portable TV cameras should be possible.

Pressurized air system as well as distribution of water and electricity shall be arranged in the vicinity of planned places of work.

Working places shall not be left dark in case of loss of electricity, since the emergency lighting systems shall be so designed that it is safe to leave the buildings.

5

AUTHORITY SUPERVISION

The Preliminary and Final Safety Analysis Report of a nuclear power plant shall include descriptions revealing how the requirements and recommendations given in sections 3 and 4 of this guide have been or will be effected in the design and construction of the nuclear power plant. These descriptions are submitted to the authorities for approval. The descriptions need not be presented as one document but they can consist of several pieces in the Safety Analysis Report, separate descriptions or reports.

The assessment of the collective dose induced by the plant operation is an important part of the planning of the plant radiation safety, and descriptions of it shall be presented to the authorities for approval in connection with the PSAR and FSAR. All significant anticipated activities causing radiation doses during plant operation shall be taken into account. Activities which are expected to cause a collective dose exceeding 0.01 manSv (1 manrem) per year are considered significant. The Safety Analysis Reports shall include a summary of the dose assessments and a sufficiently detailed description of anticipated factors causing doses. These shall be presented on forms which include the doses induced by activities concerning radiation protection, operations, service and maintenance, periodic inspec-

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tions and fuel and waste treatment. The forms describing the activities shall give the average dose rate of the object of work, working time, number of workers and the recurrence of the activity. Dose estimates for unusual operations shall be presented in a similar manner, if possible.

6 REFERENCES

1. GRS, Translation - Safety Codes and Guides, Edition 14/78: The Precautionary Protective Measures to be taken during the Planning of the Plant.

2. Commission of the European Communities, Nuclear Science and Techology: Recommendations to designers aimed at minimizing radiation dose incurred in operation, maintenance, inspection and repair of light water reactors, 1978.

3. U.S.NRC, Draft Regulatory Guide and Value/Impact Statement March 1979, Division 8, Task OH 507-4, Proposed revision 4 to Regulatory Guide 8.8, Information relevant to ensuring that occupational radiation exposures at nuclear power stations will be as low as is reasonably achieveable (ALARA).

4. U.S.NRC, Regulatory Guide 8.19, Occupational Radiation Dose Assessment in Light-Water Reactor Power Plants Design Stage Man-Rem Estimates, Revision 1, June 1979.

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