Reporting nuclear power plant operation to the Finnish Centre for Radiation and Nuclear Safety

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1 Introduction

Regulatory control of the operation of nuclear power plants is one of the major functions of the Finnish Centre for Radiation and Nuclear Safety (STUK). The scope of control includes i.a. review of documents and other reports submitted to STUK, independent safety analyses as well as on-site inspections.

Regular and prompt reports on plant operation and operational events submitted to STUK by the power company are one prerequisite for effective control.

An essential objective of reporting is that the safety significance of operational events and the need for operational or plant modifications are evaluated by both the power company and STUK. By means of the reports it shall be possible, even afterwards, to assess and analyse plant operation and operational events.

This guide sets forth what plant operation related notifications and reports STUK requires and how these are submitted to STUK. The guide does not address reports related to nuclear safeguards which are covered by Guide YVL 6.11 *Reports on nuclear material*. Reports on events related to physical protection are dealt with in Guide YVL 6.20 *Physical protection of nuclear power plants*. Furthermore, reports on individual occupational radiation doses are addressed in Guide YVL 7.10 *Individual monitoring and reporting of radiation doses*, and reports on environmental radiation monitoring in Guide YVL 7.8 *Reporting radiological control of the environs of nuclear power plants to the Institute on Radiation Protection*.

STUK also utilizes the reports submitted to it when compiling its publications *Operation of Finnish Nuclear Power Plants* and *Safety-Related Events at Finnish Nuclear Power Plants*. Reports included in the latter publication are also sent to the IAEA and the OECD/NEA as so called IRS reports (Incident Reporting System).

2 General requirements

Reports on nuclear power plant operation are divided into two groups:

- regular reports and
- event-specific reports.

Reports in the first category present information in standardized form on the basis of which an overview of the operation of a plant can be formed. Requirements for the contents and compilation of regular reports are presented in Chapter 3 of this Guide.

The other group of reports deals with events of which detailed reports are to be submitted. Reports of these events are drawn up in compliance with Chapter 4 of this Guide. The reports shall be provided with unambiguous identification markings.

The reports are submitted to STUK for information with the exception of the special report referred to in sub-section 4.1 which is submitted for approval.

The utilities shall have written instructions which define responsibilities and obligations applicable in the drawing up, inspection and approval of each report. Daily reports shall be reviewed by the shift manager or his foreman.

When drawing up and compiling the reports, Guide YVL 1.2 *Formal requirements for the documents to be submitted to the Institute of Radiation Protection* shall be taken into account. In case a report submitted to STUK is later found to be erroneous or incomplete, the necessary corrections and additions shall be made.

The measures presented in the reports shall be so monitored that their implementation can be ascertained by documentation.

3 Regular reports

3.1 Daily report

The daily report is communicated to STUK daily by telex/telefax by ten o'clock on the working day following each report period.

In the report the following information is presented, where applicable:

a) Operational data

- average power level during 24 hrs (reactor power as percentage of rated power, gross electrical power as megawatt units),
- operational state and
- changes in operational state, power changes beyond 5 % or other significant events affecting operation.

b) Inoperability of systems and components referred to in the Technical Specifications (TTKE) due to a failure, preventive maintenance or some other cause.

Systems and components referred to in the Technical Specifications are components for the operability of which requirements are set in the Technical Specifications. The requirement to report remains the same whether or not a deadline has been set for component repair or if some other condition is stated in the Technical Specifications. Also, failures in the auxiliary systems which prevent the use of a Tec Spec component in the manner designed are considered Tec Spec component failures.

In the daily report the failures are reported in consequence of which a system or component is declared inoperable. This information is also given if a component failure (e.g. a stuck valve) has been discovered during the first test but the component has functioned in the manner designed in an immediate re-test.

Component inoperability other than failure-induced is reported if, according to the Technical Specifications, the component should be operable in the operational state concerned.

In the report, component code and the direct cause of inoperability are stated. Furthermore, the following information is given:

- time and method of detecting potential failure,
- conditions set forth in the Technical Specifications,
- (sub-)systems rendered inoperable by failure,
- number of failure report/work permit,
- when component became inoperable and
- when component became operable again.

If a component has not been repaired by the end of a 24-hour reporting period, information related to the repair is given in the next daily report.

c) Notification of other unusual events and observations as well as such significant issues which warrant the drawing up of one of the reports referred to in section four. Other unusual events are e.g.

- fire hazard e.g. in consequence of an oil or hydrogen leak,
- fuel failure - ascertained or suspected,
- releases of radioactive material off-site if their weekly mean value is greater than 5 x Standard Release Rate (see Guide YVL 7.1 *Limitation of public exposure from nuclear installations*) and
- exceptional indoors fluid and gas leaks on-site.

Furthermore, information of scheduled outages shall be given in the daily report according to Guide YVL 1.13 *Regulatory inspections relative to shutdowns at nuclear power plants*.

Information relating to events or observations is presented in so far as known when drawing up the daily report. If necessary, the information given is corrected or complemented in the next daily reports.

3.2 Monthly report

The report is submitted to STUK for information by the 15th day of the month following the reporting month.

The following information is given in the report:

a) Plant operational data:

- diagram of electrical power production (gross or net power) and
- the following information for the reporting month, current year and as of start–up: gross and net electrical powers generated as well as, energy and time coefficients.

b) Summary of power reductions beyond 5 % and outages:

- power changes of reactor and generator and when these took place,
- event cause(s) and
- most important work assignments and operational measures performed in the course of the event.

c) Reactor operation and use of fuel:

- information on fuel burn–up (mean total core burn–up as well as the increase in burn–up obtained during the report period, highest bundle–specific burn–up),
- highest monthly rod–specific linear power (PWR),
- highest monthly local heat flux and smallest local dry–out margin (BWR),
- estimated fuel cladding leaks and
- causes of possible deviations from Tec Spec limiting values, or other unusual events.

d) A description of the inoperabilities of systems and components referred to in the Technical Specifications:

- description of the cause of a failure or other inoperability (component failure, human error, preventive maintenance, testing, simulation, design error),
- how an inoperability affects the ability to perform of the (sub–)system concerned,
- Tec Spec conditions and deviations therein,
- time and method of failure detection,
- period of time a component was out of operation (also estimated period of component inoperability prior to failure detection) and
- corrective measures (immediate and those to be carried out later) related to components and/or instructions.

e) A list of amendments to components referred to in the Technical Specifications. The date and cause of the amendment and the measures accomplished are given in the list.

f) The volumes of controlled releases as specified in the Technical Specifications and a report of any releases of exceptional volume.

g) A list of amendments and exemptions suggested to and approved in the Technical Specifications.

h) A report of the most important non–controlled releases.

i) The highest weekly values of specific activities of important radionuclides measured in the primary and secondary circuits. If, during the month in question, any of the below events have occurred at the plant

- fuel failures,
- events which affect the release of corrosion products or
- changes in primary to secondary leaks,

changes in the activity of nuclides relevant to the mentioned events are specified.

j) Collective occupational radiation dose.

3.3 Annual report

An annual report of the previous calendar year's operation is submitted to STUK by 1 April of the next year.

Apart from an overall summary, the annual report also presents the information listed below:

a) Plant operational data:

- diagram of reactor thermal power production,
- diagram of electrical power production (gross or net power),
- the following information for the report period and as of start–up: thermal power generated, gross and net electrical powers generated as well as energy and time coefficients, and

- plant operation since start–up as diagrams of annual energy coefficients, duration of annual maintenance outages and number of scrams.

b) Events significant to safety:

- list of special reports drawn up in a year.

c) Pressure and heat transients to which various parts of the primary circuit as well as other fatigue loaded pressure vessels have been subjected:

- number of various pressure and heat transients which have served as design basis for parts of the primary circuit or other fatigue loaded pressure vessels as well as changes in temperature or pressure greater than transients postulated in the design.

d) Reactor operation and use of fuel:

- development in a year of parameters (diagrams) for thermal margins, power distribution and reactivity control registered in connection with the control of reactor operation,
- fuel failures possibly detected or suspected in a year,
- number of fuel assemblies loaded in the reactor, specified as follows: manufacturer, type, average enrichment level,
- average and highest burn–up of fuel assemblies removed from the reactor as well as the number of assemblies specified as follows: manufacturer, type, period of use in the reactor, and
- number of fuel assemblies transported to and from the facility.

e) Water chemistry:

- diagrams of the most important chemical properties as well as the amount of impurities and radionuclides measured in reactor water, feed water and fuel pool water.

f) Liquid waste storage:

- volume and total activity of stored radioactive waste as well as the most important radionuclides contained in the waste.

g) Solid waste storage and transport:

- volume and total activity of stored radioactive waste as well as the most important radionuclides contained in the waste and
- volume and total activity of radioactive waste removed from the site and exempted from regulatory control as well as the most important radionuclides contained in the waste; place and method of storage.

h) Releases:

- summary of releases of radioactive material and radiation doses caused by them off–site.

i) Occupational dose information:

- diagram of collective annual occupational radiation doses since start–up,
- individual occupational radiation dose distribution into doses of various sizes,
- collective radiation dose received by various worker groups, number of persons who received doses and the highest individual dose; furthermore, distribution into utility personnel and external workforce, e.g. operating personnel, radiation protection personnel, service and maintenance personnel (insulators, electrical workers, instrumentation workers, machine maintenance personnel, in–service inspectors, fuel handlers, waste handlers),
- work from which doses exceeding 0.02 manSv have been received; work is divided into cyclic or repeated operations (e.g. refuelling, maintenance of steam generator etc) and occasional exceptional work; name or object of work, collective radiation dose, highest individual dose, number of workers and duration of work are given as well as
- possible registration of internal doses (for further instructions, see Guide YVL 7.10).

j) Changes in permanent plant personnel.

3.4 Outage report

The length of a report addressing the implementation of an outage depends on the

outage. Reports on unscheduled maintenance outages are submitted to STUK in a month and reports on refuelling and comparable extensive outages in three months from the end of the outage.

Further instructions are given in Guides YVL 1.8 *Repairs, modifications and preventive maintenance in nuclear facilities* and YVL 1.13.

3.5 Environmental radiation safety reports

A report containing the previous calendar year's results is submitted to STUK by 1 May of the next year. The report presents i.a. a summary of plant unit operation from the environmental radiation safety point of view, data on releases and dispersion, dose calculations and the results of radiological monitoring based on environmental measurements as well as information on waste exempted from regulatory control. Furthermore, information on releases, dispersion conditions and on the results of environmental radiation monitoring are submitted to STUK in a month from end of every annual quarter. The environmental radiation safety report is addressed in detail in Guide YVL 7.8.

3.6 Reports on individual radiation doses

Individual occupational doses of external radiation are reported monthly for inclusion in the central dose file maintained by STUK. Internal radiation doses are included in the monthly report which follows the investigated observation. Reports on individual radiation doses are addressed in detail in Guide YVL 7.10 and overexposure and accidents in Guide YVL 7.12, *Medical examination of nuclear power plant personnel and actions in case of overexposure and accidents*.

4 Event reports

This chapter deals with event reports and notifications. An event may also be such that, according to instructions, two or more different reports should be submitted on it (e.g. an event including a scram and pressure vessel damage of which a special report shall be submitted). In such a case only one report may be drawn up which is provided with the identifying mark of each type of report.

4.1 Special events

Special events are incidents, failures, observations, shortcomings and problems (later in the text jointly called events) which have special significance to the plant's nuclear safety, safety of the plant personnel or radiation safety in the plant's vicinity .

The list below gives examples of events considered special events.

Emergencies

a) A plant or general emergency situation has been declared at the plant.

Special events related to the Technical Specifications

b) The plant has been operated in a manner which is against the Technical Specifications.

c) Power operation has had to be interrupted owing to a requirement in the Technical Specifications.

d) A limit defined in the Technical Specifications, which serves to secure the integrity of fuel cladding or that of the primary circuit pressure boundary, has been exceeded.

Events relating to the actuation of safety functions.

e) The reactor emergency core cooling system or containment building isolation has been actuated. Isolation of certain process systems, which takes place after a scram, usually is not considered containment building isolation as referred to here.

f) The automatic protection function has not been actuated even though some parameter has exceeded the protection limit defined in the Technical Specifications or the protective function has not been carried out as designed.

Damage to and failure of systems and components

g) One of the following conditions has been discovered: an increase in reactor coolant activity indicative of the failure of several fuel rods, an exceptional leak or degradation of the primary circuit or degradation of the reactor containment building so that it no longer meets the requirements set for leak tightness and strength.

h) A component failure, functional deficiency, erroneous process or electrical connection, incorrect instruction or some other reason has been detected which could prevent a safety function as postulated in some accident analysis or some other basis for the Technical Specifications.

i) Recurrent faults have been detected in an important component type relating to some safety function and a decision has been made to carry out corrective measures to enhance safety.

j) Faulty or deficient funtioning of a safety or pressure relief valve in the primary or secondary circuit has been discovered.

k) An indoors gas or liquid leak has occurred at the plant. Circumstances thus created compromise or may compromise the performance of a safety function.

Deficiencies in safety assessment

l) The reactor multiplication factor ascertained in the steady state has deviated by more than one per cent from the value anticipated for that state or the possibility of unexpected criticality in the reactor or outside it has been ascertained.

m) An error in some accident analysis or in some method of analysis or some other erroneous basis for the Technical Specifications has been discovered and there is reason to believe that plant operation during some events is not as safe as previously assessed.

Events related to radiation safety

n) An uncontrolled release of radioactive material indoors has occurred at the plant resulting in an essential increase in air or surface contamination or in the radiation dose rate in the rooms concerned.

o) Some individual has received a radiation dose possibly resulting in overexposure (see Guide YVL 7.10).

p) Releases of radioactive material off-site have exceeded the limit for corrective measures (see Guide YLV 7.1).

External events

q) An exceptional natural phenomenon or other external threat against the plant has brought about a situation where power restriction or some other protective measure has been considered necessary.

r) A fire or an explosion has occurred at the plant

s) Loss of external electricity grid has occurred as the consequence of which the plant has been supplied AC power by own internal power units.

Other events

t) A fuel assembly has or may have become damaged during handling or its safety has been threatened in consequence of some other abnormal event.

u) A safety threat or an attempt to deliberately damage the plant has been noted or a significant shortcoming in physical protection has been discovered.

v) Unsolved deficiencies have been discovered in nuclear material inventory or there is other reason to believe that nuclear material has been lost.

STUK reports safety significant events to the IAEA and OECD/NEA (the IRS systems) in the extent it deems necessary. In classifying the events STUK complies with the guide referred to in Ref. /1/.

Special report

A report of special events (a special report) is submitted in two weeks from the event. Where a lenghtier investigation is required however, parts of the report which contain

only event description and preliminary safety assessment are first submitted. The rest are submitted when investigations relating to the event have been accomplished and the decision about possible corrective measures has been taken. The report presents the following information, where appropriate:

Summary

- operational condition and power level of the plant during the initiating event,
- discovery of the event,
- brief chronological description of the event,
- personal injuries and the radiation doses received,
- releases of radioactive material,
- root causes and
- measures to ensure safety and to avoid recurrence.

Event description

1 The operational condition of the plant during the initiating event:

- operational state and power level of the plant,
- status and functioning of systems and components associated with the event,
- operational and maintenance work associated with the event in progress at the time and
- alarms prior to the event or other deviations from normal operation.

2 Event discovery

3 Chronological event progression:

- failure or malfunction which initiated the event,
- automatic control and protection functions,
- actions by the operators and other personnel to ensure safety and
- failures and malfunctions which affected event progression.

4 Consequences of the event (e.g. changes in plant operational state, personal injuries, radiation doses, releases of radioactive material off-site)

5 Diagrams of process behaviour (e.g. pressure, temperature, flow):

- plant status prior to the event,
- changes in parameters and
- flow charts, electrical diagrams, logic diagrams etc of systems associated with the event.

Safety assessment

1 An overall assessment of the event's safety significance

2 The event's impact on ensuring the most important safety functions:

- reactor shutdown,
- reactor cooling,
- removal of residual heat from the reactor and spent fuel and
- isolation of radioactive materials from the environment

3 Potential consequences of the event under some other operational conditions

4 Reference to similar events which have occurred in the same nuclear power plant earlier.

Causes of the event

1 Direct causes

2 Root causes

Measures to prevent recurrence

1 Summary of the reports and investigations accomplished

2 Event review by the safety and quality assurance organizations

3 Structural improvements at the plant (both direct corrective measures as well as those to be implemented later)

4 Improvements in the Technical Specifications, procedures, instructions and training etc.

Notification of a special event

In case of an emergency, STUK is alerted according to instructions contained in the utility's emergency plan. During office hours, the alarm is given by the alarm phone and outside office hours STUK's duty officer is notified. An emergency is a situation in which the plant's safety is in jeopardy of deteriorating, or deteriorates, considerably.

Safety significant transients shall be communicated promptly to STUK according to instructions issued by STUK. It is characteristic of events which require immediate notification that

- emergency operating procedures have been devised to provide against the event,
- transient has actuated a safety system, or that
- there are unanticipated component failures or personnel errors associated with the transient.

Immediate notification shall also be made if breach of radiation dose limits is ascertained or suspected.

All special events are, according to STUK's instructions, promptly communicated to STUK by telephone during office hours and also in the next daily report.

4.2 Reactor scrams

Scram report

Scram reports,with the exception of scheduled scram tests at low power, are submitted to STUK not later than four weeks from the scram. In the report such information is presented, where appropriate, as, according to sub-section 4.1, is required for inclusion in a special report.

Notification of a scram

STUK is notified of a scram by telephone during office hours according to STUK's instructions and also in the next daily report.

4.3 Operational transients

Report on an operational transient

Significant operational transients which have lead to a forced reduction of reactor or generator power are reported as well as other significant transients which have occurred when operating the plant or its systems. The report is submitted to STUK not later than four weeks from the event. In the report such information is presented, where appropriate, as, according to sub-section 4.1, is required for inclusion in a special report.

Notification of an operational transient

An operational transient which is not classified as a special event and which does not result in a scram is notified in the next daily report.

4.4 Pressure vessel damage

Report on pressure vessel damage

A report on damage is submitted to STUK in the form of a special report, if so required under sub-section 4.1.

Notifying pressure vessel damage

STUK is notified by telex or telefax if damage to a pressure vessel or its auxiliaries occurs during operation. Notification is required in the following cases:

- pressure vessel is damaged or otherwise ascertained as deviating from the construction plan (e.g. leaks through the construction material or joints, collapse of supports, non-conformances resulting in repair by welding, events which have compromised the safe use of the structure),
- pressure vessel has been used in an incorrect manner (e.g. non-compliance to operational parameters) or
- pressure vessel safety valve has not operated in the manner designed.

The following information shall be included in the notification:

- damaged item and method of detecting the damage,
- description of the damage and
- preliminary plans for measures (method of repairing the damage, additional inspections, schedule for measures etc.).

References

1 Systems for Reporting Unusual Events in Nuclear Power Plants, IAEA Safety Series No.93, IAEA Safety Guides, 1989.

This guide is valid as of 1.11.1989 until further notice.
This guide replaces Guide YVL 1.5 issued on 24.4.1981.