

		<b>WORKING PROCEDURE</b>	<b>Allocation Centre 38A</b>	<b>Reference Number KWH-S-045</b>	<b>Rev 15</b>
<b>NNR: NO No.:</b>	<b>RADIATION PROTECTION REQUIREMENTS FOR INDUSTRIAL RADIOGRAPHY ON SITE</b>				<b>PAGE 1</b>
<b>KORC NO</b>	<b>ACCESS</b> Nuclear Restricted	<b>IMPORTANCE CATEGORY</b> NSA	<b>NEXT REVIEW DATE</b> 2025-09-09	<b>DATE AUTHORISED</b> 2020-09-09	

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T MAKGALATIBA	B DE WAAL	T KARSTEN
SENIOR RADIATION PROTECTION ASSISTANT	SENIOR SUPERVISOR RADIATION PROTECTION	RADIATION PROTECTION MANAGER
<b>DATE</b> 2020-09-04	<b>DATE</b> 2020-09-04	<b>DATE</b> 2020-09-09

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<b>CATEGORY 1 – PROCEDURE IN HAND</b>		
<b>FCA</b>  PROTECTION	<b>ALARA REVIEW</b> YES 2020-08-27	<b>SUPERSEDES</b> KWH-S-045, Rev 14a dd. 2020-02-26 FULL REVIEW

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## **1.0 PURPOSE**

- 1.1 To stipulate requirements for the following:
  - 1.1.1 Duties of Radiation Protection personnel before radiography work is conducted on site.
  - 1.1.2 Duties of Radiation Protection personnel during radiography work on site.
  - 1.1.3 Duties of Radiation Protection personnel on completion of radiography work conducted on site.
  - 1.1.4 Duties of the RT Co-ordinator.

## **2.0 SCOPE**

- 2.1 Applicable to all NDT radiation work being conducted on Eskom premises, at Koeberg Nuclear Power Station.

## **3.0 DEFINITIONS AND ABBREVIATIONS**

### **3.1 Definitions**

- 3.1.1 **Acting Radiation Protection Officer (Source Control)** – A person appointed in writing by the Power Station Manager, and who must ensure compliance with the conditions of the licence applicable to the Group III and IV hazardous substances.
- 3.1.2 **ALARA** – Acronym for “As Low As Reasonably Achievable”, a basic concept of radiation protection that specifies that radioactive discharges from nuclear plants and radiation exposure to personnel be kept as far below regulation limits as feasible.
- 3.1.3 **Approved** – Approved by the Directorate: Radiation Control, Department of Health.
- 3.1.4 **Approved Source Store** – Source store in accordance with KWH-S-041.
- 3.1.5 **Approved Storage Location** – An additional area approved by the RPO (Source Control) in writing. The area shall be locked and entry controlled.
- 3.1.6 **Authorised RPM** – A Radiation Protection Monitor qualified in accordance with KSA-049.
- 3.1.7 **Barrier** – A physical obstruction.

- 3.1.8      **Barrier Guards** – Any Radworker or non Radworker posted at an entry point to prevent inadvertent access to the Radiography restricted area.
- 3.1.9      **Biological Monitoring** – A planned programme for periodic collection and analysis of body fluids.
- 3.1.10     **Ci** – Curie: Non-SI unit of activity still used on source holders and documentation presented to Koeberg.
- 3.1.11     **Collimator** – A small radiation shield of lead or other heavy metal used in radiography. A collimator, which is placed on the end of the guide tube, has a small opening through which a narrow cone of radiation escapes when the source is cranked into the collimator. Use of a collimator can greatly reduce the size of the controlled area to which access must be restricted.
- 3.1.12     **Gamma Radiography** – Industrial radiography performed with gamma radioactive sources.
- 3.1.13     **GMR-2.1** – General Machinery Regulations site representative.
- 3.1.14     **Guide Tube** – A flexible or rigid sheath or tube for guiding the source assembly from the source container to the working position.
- 3.1.15     **High Volume Radiography Work** – Outage repair, replacement work and inspections.
- 3.1.16     **Industrial Radiography** – A person Authorised by the Directorate: Radiation Control, Department of Health to perform Industrial Radiography.
- 3.1.17     **Line Group** – An Eskom line group, for example Project Engineering or Inspection and Test, who is given functional responsibility for an NDT activity (i.e. is responsible for the supervision, execution, evaluation and the Eskom acceptance of NDT results).
- 3.1.18     **Low Volume Radiography Work** – Annual renewable low volume content non-outage.
- 3.1.19     **Medical Surveillance** – A planned programme of periodic examinations (which may include clinical examinations, biological monitoring or medical tests) by an Occupational Health Practitioner.
- 3.1.20     **Occupational Health Practitioner** – An occupational medical practitioner or nurse practitioner with a qualification in occupational health recognised by his / her statutory councils.
- 3.1.21     **Overexposure** – Any exposure of a person to ionising radiation to an extent that the legal limits are exceeded.

- 3.1.22 **Portable Radiation Dose Rate Instrument** – A radiation monitoring instrument with a valid calibration certificate that has been source checked.
- 3.1.23 **Primary X-ray Beam** – X-radiation emitted directly from a target within the x-ray tube and emerging through the window of the X-ray Generator head.
- 3.1.24 **Radiation Protection Controller** – Radiation Protection Controllers are appointed by management in writing in order to supervise radiography activities on Eskom premises.
- 3.1.25 **Radiation Protection Officer (Radiography) (RPO Radiography)** – A Level III person certified in radiography, or a Level II radiographer with Directorate: Radiation Control of the Department of Health approval.
- 3.1.26 **Radiation Protection Officer (Source Control)** – A person appointed in writing by the Power Station Manager, and who must ensure compliance with the conditions of the licence applicable to the Group III and IV hazardous substances.
- 3.1.27 **Radiographer** – Any individual who performs or who, in attendance at the site where the radiography source is being used, personally supervises radiographic operations.
- 3.1.28 **Radiography Restricted Area** – An area with established boundaries defined and posted by Radiation Protection for assuring that unauthorised personnel are prevented from entering the radiography area.
- 3.1.29 **Radiography Source Cabinet** – A cabinet with more than one lockable cubicle.
- 3.1.30 **RT Co-ordinator** – Individual designated to co-ordinate radiography on site and prepare RT Work Plan packages.
- 3.1.31 **Source Assembly** – The pen shaped device or pigtail in which a sealed radioactive nuclide is incorporated.
- 3.1.32 **Source Container** – The shielding container in which a sealed radioactive source is transported and stored.
- 3.1.33 **TLD** – Thermoluminescent dosimeter that measures and records the amount of radiation that an individual is exposed to.
- 3.1.34 **Work Scope** – Consist of: Scope, Source exposure location, Rooms / components, RT Technique (Source, X-ray, Soil Moisture and Density gauges) and use of collimator. Refer to KFH-HP-148.
- 3.1.35 **X-ray Generator** – A directional (X-ray focus tube) or panoramic (X-ray head).

3.1.36 **X-ray Machine** – An assembly of components, including an X-ray tube, X-ray Generator and its housing and shielding, designed and constructed for the controlled generation of X-rays.

## **3.2 Abbreviations**

3.2.1 **μSv** – microSievert

3.2.2 **ACP** – Access Control Point

3.2.3 **ALARA** – As Low As Reasonably Achievable

3.2.4 **AP (RP)** – Authorised Person (Radiation Protection)

3.2.5 **Bq** – Becquerel

3.2.6 **BU** – Business Unit

3.2.7 **Ci** – Curie

3.2.8 **CR** – Condition Report

3.2.9 **DRC** – Directorate: Radiation Control, Department of Health

3.2.10 **DRD** – Direct Reading Dosimeter

3.2.11 **GBq** – Giga becquerel

3.2.12 **GS & AM** – Generation Safety & Assurance Manager

3.2.13 **IAEA** – International Atomic Energy Agency

3.2.14 **ICRP** – International Commission on Radiological Protection

3.2.15 **KRT** – Plant Radiation Monitoring System

3.2.16 **mSv** – milliSievert

3.2.17 **NAB** – Nuclear Auxiliary Building

3.2.18 **NDT** – Non-destructive Testing

3.2.19 **NECSA** – Nuclear Energy Corporation South Africa

3.2.20 **OCC** – Outage Control Centre

3.2.21 **OE** – Operational Experience

3.2.22 **OH & SA Act** – Occupational Health and Safety Act (Act No. 85 of 1993)

3.2.23 **PSR** – Plant Safety Regulations

- 3.2.24 **PTW** – Permit to Work
- 3.2.25 **RP** – Radiation Protection
- 3.2.26 **RP Controller** – Radiation Protection Controller
- 3.2.27 **RPC** – Radiation Protection Certificate
- 3.2.28 **RPM** – Radiation Protection Monitor
- 3.2.29 **RPO (Radiography)** – Radiation Protection Officer (Radiography)
- 3.2.30 **RPOO** – Radiation Protection Operations Office
- 3.2.31 **RT** – Radiographic Testing using either a Radioisotope or X-ray Generator
- 3.2.32 **RTWP** – Radiographic and Soil Moisture & Density Gauge Source Test Work Plan
- 3.2.33 **SABS** – South African Bureau of Standards
- 3.2.34 **SAP** – Systems Application Production (Work Order)
- 3.2.35 **SAP (RP)** – Senior Authorised Person (Radiation Protection)
- 3.2.36 **SRPA** – Senior Radiation Protection Assistant
- 3.2.37 **TBq** – Tera Becquerel
- 3.2.38 **TD & RM** – Technical Documentation & Records Management

## **4.0 REFERENCES**

### **4.1 Referenced Documents**

- 4.1.1 238-54, Rev 0: Radiological Protection Licensing Requirements for Koeberg Nuclear Power Station
- 4.1.2 335-2, Rev 5: Koeberg Nuclear Power Station Management Manual
- 4.1.3 EPL 32-227, Rev 2: Radiation Protection and the Safety of Radiation Sources
- 4.1.4 EPRI 1022356: Non Destructive Evaluation: Recommended Practices for maintaining Radiation Safety of Radiographic Operations at Nuclear Plants
- 4.1.5 EST 32-226, Rev 0: Requirements and Rules for Radiation Protection and Safety of Radiation Sources



- 4.1.6 KAA-500, Rev 13: The Process for Controlled Documents
- 4.1.7 KAA-632, Rev 10: ALARA Programme
- 4.1.8 KSA-011, Rev 14: The Requirements for Controlled Documents
- 4.1.9 KSH-001, Rev 9: The Administration and Quality Control of Radiation Dosimetry
- 4.1.10 KWH-I-093, Rev 2a: Radiation Protection Operation and Use of Portable Area Radiation Monitors
- 4.1.11 KWH-I-094, Rev 3a: Operation and Use of Radiation Protection Portable Radiation Instruments
- 4.1.12 KWH-S-001, Rev 20: Radiation and Surface Contamination Surveys
- 4.1.13 KWH-S-007, Rev 10: Leakage Tests on Sealed Radioactive Sources
- 4.1.14 KWH-S-043, Rev 15: Control of Red Radiation Zones and Radiation Protection Locked Zones

## **4.2 Applicable Documents**

- 4.2.1 238-40: Radiation Protection Safety Requirements for Industrial Radiography
- 4.2.2 KAA-633: Control of Radioactive Sources and X-ray Equipment
- 4.2.3 KAH-002: Radiation Surveillance Programme
- 4.2.4 KFH-HP-015: Use of Radiography / Soil Moisture & Density Gauge Source and X-ray Machine on Koeberg Site
- 4.2.5 KFH-HP-016: Source Log Book
- 4.2.6 KFH-HP-022: Radiography / Soil Moisture & Density Gauge Source and X-ray Machine Arrival On Site
- 4.2.7 KFH-HP-142: Radiation Protection Controller Radiography Checklist
- 4.2.8 KFH-HP-143: RPM Checklist for Gamma Radiography Job Coverage
- 4.2.9 KFH-HP-144: RPM Checklist for Receipt of Gamma Radiography Source at Koeberg
- 4.2.10 KFH-HP-145: RPM Checklist for Removal of Gamma Radiography Source at Koeberg
- 4.2.11 KFH-HP-146: RPM Checklist for X-ray Radiography Job Coverage

- 4.2.12 KFH-HP-147: RPM Checklist for Receipt and Removal of X-ray Radiography Machine at Koeberg
- 4.2.13 KFH-HP-148: Work Plan For Gamma, X-Ray Radiography and Soil Moisture & Density Gauge Source Test
- 4.2.14 KFH-HP-149: Pre-job Brief for Gamma and X-ray Radiography
- 4.2.15 KGH-010: Radiation Protection Response to Incidents / Alarms
- 4.2.16 KSA-049: Koeberg Training Standard
- 4.2.17 KSH-008: Radiation Protection Records, Data and Information Management
- 4.2.18 KWH-I-063: Radiation Protection KRT Functions
- 4.2.19 KWH-S-041: Radiation Protection Source Control

## **5.0 PREREQUISITES**

### **5.1 General:**

- 5.1.1 A radiation and contamination survey must be performed on radiography equipment prior to receipt on site.
- 5.1.2 Any radiography equipment that becomes contaminated while on site may not be removed until the equipment has been decontaminated.
- 5.1.3 A Senior Authorised Person (RP) must authorise the receipt of radioactive sources to and from the site.
- 5.1.4 All radiography on Eskom Premises, at Koeberg must be approved by the RP Controller and a SAP (RP).
- 5.1.5 All radiography on plant shall have a PTW. If no PTW is required for non-plant items/exposures, a letter shall be issued by the GMR-2.1 site representative or the PSR Custodian for the work to be performed. The authorisation letter will be kept in the Duty SRPA's office attached to the relevant RT WP, KFH-HP-148.
- 5.1.6 Work Scope changes (refer to 3.1.34) and changes to the minimum requirements of lead shielding or minimum total of barrier guards are subjected to a new RT WP.
- 5.1.7 RPC revision numbers and other RT WP / map changes may be performed by the RP Controller after hours.

- 5.1.8 Anticipated exposure start and stop date / time extensions will only be subjected to the approval of the appointed Senior Supervisor Plant. This approval will be determined by the available manpower, for planning purposes.

**NOTE:** *The Senior Supervisor Plant, signs an agreement that RP manpower is available, for the RT's to be conducted. Anyone delegated by the Senior Supervisor Plant may sign for RP manpower. Concurrent work, as well as available barrier guards, will be considered.*

- 5.1.9 Only radiography technicians that are qualified and approved by the DRC may perform radiography on Eskom Premises, at Koeberg.
- 5.1.10 The radiography should be performed in the best window of opportunity as determined during the RT Work Plan preparation. The preferred time is during the night.
- 5.1.11 A teletector and an ion chamber shall be used for gamma radiography. An ion chamber to be used for X-ray radiography.
- 5.1.12 All radiography sources arriving on-site to be logged in N040 radiography source cubicles first.
- 5.1.13 The same number must be assigned to the radiography source cubicles in N040, NAB and Reactor Building.
- 5.1.14 Only one key and padlock must be assigned to each corresponding radiography source cubicle.
- 5.1.15 Allocate key positions for each cubicle in the red zone key press.
- 5.1.16 The checklists KFH-HP-143, KFH-HP-146 shall be used at the job-site as applicable.

**NOTE:** *For Radiography in non-control zones the barriers will be set-up at less than 2.5  $\mu$ Sv/h.*

- 5.1.17 Ensure that the thresholds 1 and 2 on any KRT within the radiography restricted area are raised in accordance with KWH-I-063, before radiography is started.

**NOTE:** *In the case where the KRT threshold values may not be raised i.e. effluent release KRT's, shielding shall be applied to prevent alarms.*

- 5.1.18 When radioactive sources exceeding 1100 GBq (30 Ci) of Iridium or 300 GBq (8 Ci) of Cobalt or 2400 GBq (65Ci) of Selenium-75, the following procedures shall apply:
- Two qualified Industrial Radiographers shall be present at all times during use of the radioactive source.

- b. Emergency equipment for example, additional shielding material, long-handled tongs, emergency transport containers, etc., should be present at the site where the work is performed.

**NOTE:** *Ci values still included as RT equipment and documentation presented to Koeberg still use these units. Values added to provide clarity to the RPM staff.*

- 5.1.19 Ensure that a formal communication protocol is established and noted in the applicable RPC and RTWP.

## 5.2 Radioactive Sources

- 5.2.1 When the source assembly is in the shielded or “off” position, the dose rate must not exceed the following limits:

- 5.2.1.1 2 mSv/h at any point on the surface of the container.

- 5.2.1.2 At any point 1 m from the surface of the container:

- portable containers: 20 µSv/h
- mobile containers: 50 µSv/h

Portable containers are those which weigh less than 50 kg, mobile containers are those which are not portable but which can be easily moved by suitable means.

- 5.2.2 Taking the ALARA principle into account and to ensure an average dose rate of  $\pm 2$  mSv/h at the position of the winding unit, the length of the winding gear must comply with the following for open areas:

- a) When radioactive sources **not exceeding** 2,4 TBq (65Ci) of Se-75 or 1,11 TBq (30Ci) of Ir-192 or 300 GBq (8Ci) of Co-60, the winding gear must be long enough to ensure a distance of at least 8 m between the winding unit and the source container.
- b) When radioactive sources **exceeding** 2,4 TBq (65Ci) of Se-75 or 1,11 TBq (30Ci) of Ir-192 or 300 GBq (8Ci) of Co-60 the winding gear must be long enough to ensure a distance of at least 15 m between the winding unit and the source container.

- 5.2.3 A radiography source may only be left unattended when the source is in an approved storage location, and the source must be in the locked position.

**NOTE:** *If a source needs to be transported in a lift, a barrier guard to be positioned at each level where the lift doors can be opened to avoid inadvertent access to the lift during transit of the source.*

- 5.2.4 A radiography team operating one radiography unit must consist of one radiographer and at least one assistant. The assistant shall be capable of promptly taking charge in an emergency and shall be able to:
- 5.2.4.1 Ensure that no person remains in an area where the dose rate exceeds or might exceed 25  $\mu\text{Sv/h}$  (Controlled Zones) or 2.5  $\mu\text{Sv/h}$  (Non-Controlled Zones) .The controls as per KAH-002 shall be applied.
- 5.2.4.2 Recognise a loose gamma radiography source by being familiar with the dummy source (or its photograph) supplied with the gamma radiography equipment.
- 5.2.4.3 Inform the RPM covering the job and the duty SRPA. The Duty SRPA must do the necessary notifications as per KGH-010.
- 5.2.5 All gamma radiography sources stored in any approved source store must be registered in the appropriate Source Logbook, and all relevant fields must be completed (KFH-HP-016). (This does not apply to X-ray radiography equipment).
- 5.2.6 The radiographer must use the appropriate collimators for reduction of the field size primary beam to a minimum practicable size necessary for the performance of the work. Where it is not possible to use a collimator, other appropriate shielding material should be used.
- 5.2.7 Ensure that the guide tube is shielded, if possible and applicable.

### 5.3 X-ray Generators

- 5.3.1 The X-ray machine used at Koeberg Nuclear Power Station must have a photon energy setting > 80 keV.
- 5.3.2 When on site and when not in use the X-ray machine must be stored in an approved store, or the connection sockets of the X-ray Generator and /or the control panel must be signposted to prevent inadvertent energizing or use of the X-ray machine. Refer to Appendix 2 for signposting.
- 5.3.3 The X-ray focus tube must be enclosed in a housing in such a way that the dose equivalent rate from leakage radiation (side and back), measured at 1 metre from the focus, does not exceed the following values for the given applied voltage and corresponding maximum tube currents.
- |                          |                        |
|--------------------------|------------------------|
| – up to 150 kV           | 1 000 $\mu\text{Sv/h}$ |
| – above 150 up to 200 kV | 2 500 $\mu\text{Sv/h}$ |
| – above 200 kV           | 5 000 $\mu\text{Sv/h}$ |

For discharge X-ray equipment, the dose equivalent rate shall be defined as the dose equivalent in one hour at the highest pulse rate.

- 5.3.4 The radiation leak testing method is described in KFH-HP-146.
- 5.3.5 X-ray generation equipment must be equipped with an extension cable for remote exposure control. The length of this cable must be at least 20 metres for X-ray equipment exceeding 200 kV, and 10 metres for 200 kV or lower.
- 5.3.6 The X-ray generator control panel must not be able to operate without a key. In addition, the removal of the key after exposure must not result in damage to the equipment, e.g. overheating.

**NOTE:** *One key may fit all X-ray generators.*

- 5.3.7 The operation of the X-ray generator must only be via the control panel (accidental grounding of an electrical conductor must not result in generation of X-rays).
- 5.3.8 A red or amber indicator lamp must be provided on the control panel and must be automatically illuminated when X-ray Generator is energised. An interlock shall be provided such that if the "Beam ON" fails, X-ray Generator cannot be energised, and replacement of the lamp will not automatically re-energise the X-ray Generator. In addition some units may also have an audible indicator that signals prior to the start of the exposure and just prior to the end of the exposure.
- 5.3.9 The X-ray Generator must be distinctly marked with the following information:
- Location of focus;
  - Primary beam angle;
  - For panoramic units, the cylindrical window must be marked with a colour distinctly different from the rest of the housing.
- 5.3.10 The radiographer must supply documentary proof that the X-ray radiography equipment has been periodically tested at intervals not exceeding 24 months.

## 6.0 PRECAUTIONS AND LIMITATIONS

- 6.1 Only Radiation Protection personnel who have completed the necessary training and are authorised in may perform the functions as defined in this procedure.
- 6.2 If at any stage in the checklist, the answer to a task description cannot be “yes”, stop all further activities and contact the Duty SRPA for guidance or clarification, unless the checklist indicates “if applicable”.
- 6.3 For any emergency activity, use section 7.12 for guidance. Notification must be done in accordance with KGH-010.
- a) any person is over-exposed, or is suspected of being over-exposed.
  - b) a radioactive source is missing.
  - c) the source is damaged.
  - d) there has been a fire / explosion or flooding of a source.
- 6.4 Radiography equipment found to be contaminated before it came onto site, will be bagged, tagged and returned to the contractor. Access onto site of such equipment will be denied.

**NOTE 1:** *One key may fit all radiography sources.*

**NOTE 2:** *Some source holder labels still indicate the source activity in Curies. The activity on the documentation must be verified against the information on the source holder.*

## 7.0 PROCEDURE

### 7.1 Receipt of Non-Eskom Radiography Sources and Radiographic Equipment on Site

- 7.1.1 Users are required to notify Radiation Protection in advance of any radiography to be performed, and/or of outside radiography sources being brought on site (KAA-633).
- 7.1.2 The user must forward form KFH-HP-015, attach a copy of the Source or X-ray Certificates and Decay table (sources only), to the RP Controller and the SAP (RP) for approval.
- 7.1.3 Users will complete all the relevant information on form KFH-HP-015 and form KFH-HP-022 and forward copies of these forms to Radiation Protection Plant, the affected unit control room, and Security (KAA-633).

**NOTE:** *Complete the relevant source activity levels in GBq and not in Ci.*

- 7.1.4 The RP Controller on receiving the forms must sign to acknowledge receipt. The process is repeated with the affected unit and Security representatives.
- 7.1.5 The user must send completed copies of the forms to the RP Controller.
- 7.1.6 Radiography sources and radiographic equipment for X-ray radiography may only be received at ACP 1 or ACP 2. Security at ACP 1 or ACP 2 will immediately inform the RP Controller (Duty SRPA) of the arrival of the source (KAA-633). The RP Controller must ensure that RP has received a copy of KFH-HP-015, informing of the intended use of the source on site. If a copy of this form is not available, the RP Controller must contact the SAP (RP) to confirm that the source may be brought on site and complete forms KFH-HP-015 and KFH-HP-022, including the date and time of arrival.
- 7.1.7 Receipt of the source or radiographic equipment shall be arranged by the RP Controller.
- 7.2 Duties of the RP Controller (Duty SRPA) for Receipt of Radiography Source**
- 7.2.1 Use KFH-HP-142 and complete Parts A and B and check off as necessary.
- 7.2.2 Delegate an authorised RPM to receive the radiography source and equipment, or radiographic X-ray equipment at Security ACP.
- 7.2.3 Review the checklist in either KFH-HP-144 or PART A of KFH-HP-147, depending on the type of radiographic equipment that has been accepted. Update PART D of KFH-HP-142 and sign PART B as complete after acceptance of the source or radiographic equipment on site.
- 7.2.4 Place all applicable paperwork into the radiography file in RPOO for further use when required.
- 7.3 Duties of the RPM for Receipt of Radiography Source and Equipment or Radiographic X-ray Equipment**
- 7.3.1 Select and perform pre-operational checks on instruments.
- 7.3.2 Obtain the checklist in either KFH-HP-144 or KFH-HP-147, as applicable, and the key to N040.
- 7.3.3 To ensure that the correct radiography equipment comes onsite, RP must verify the radiography equipment upon arrival against the information on the form KFH-HP-015 which was submitted to the RP Controller as per paragraph 7.1.3.
- 7.3.4 Proceed to Security ACP.
- 7.3.5 Complete either KFH-HP-144 or PART A of KFH-HP-147 (whichever is applicable), together with the RPO (Radiography).



- 7.3.6 Make sure that the RPO (Radiography) signs Part A, then countersign.
- 7.3.7 Submit a radiological survey.
- 7.3.8 Forward the copy of the survey and either KFH-HP-144 or KFH-HP-147 to the RP Controller.
- 7.3.9 Proceed to N040 with the source. X-ray machines brought to site are normally taken to the work site. Requirements as defined in 5.3.2 to be complied with.

**NOTE:** *X-ray radiography equipment does not have to be logged in or out.*

#### **7.4 Duties of the RPM when Gamma Radiography Source is to be Stored in N040**

- 7.4.1 Place source in a vacant radiography source cabinet cubicle.
- 7.4.2 Enter the details of the source in the source logbook (KFH-HP-016) sheet and display it on the outside of the cubicle door.
- 7.4.3 Lock the cubicle and hand the cubicle key over to the Duty SRPA.

#### **7.5 Duties of the RP Controller (Duty SRPA) when Radiography Source is to be Stored in N040**

- 7.5.1 Delegate an authorised RPM to escort the radiography source to N040.
- 7.5.2 Brief the RPM as to which source cubicle is to be used and issue keys to N040.
- 7.5.3 Receive cubicle key from RPM and place in the reserved space in the red zone key press.
- 7.5.4 Update the red zone key list.

#### **7.6 Duties of the RT Co-ordinator**

**NOTE:** *The RT co-ordinator duties are assigned to a specific individual, authorised as an RT Co-ordinator, in the RP Services Section.*

- 7.6.1 When a SAP Work Order is raised for any RT work, the RT Work Plan process must be initiated. Inform the Senior Supervisor, Shifts, preferably 72 hours ahead of the scheduled work, to allow sufficient time to arrange RP resources.
- 7.6.2 Initiate the RP Work Plan assessment using KFH-HP-148.
- 7.6.3 Obtain the Source / X-ray machine / Soil Moisture & Density Gauge source data. (The Group/Department who initiates the RT request must obtain the information from the Company who will be providing the RT service).

**NOTE:** *Verify with the line Group that the following proof of authorisations has been provided by the RT service provider:*

- *Own Training certification and authorisation.\**
- *Approval to conduct RT on Eskom sites or Eskom (NE or KOU) approval via authorisation to work or by letter of recommendation from Engineering Programmes.*
- *DRC Approval for the Radiographer.*
- *DRC Approval for the RPO (Radiography).\**
- *Line Group Authorisations.*
- *Classroom attendance records.*
- *Radiation dose rate instrument valid certificate, (refer to 3.1.2.2).*
- *Eskom Authorisation Listing Report (Includes Koeberg Radiation Workers training).*
- *Equipment maintenance and certification.\**
- *Leak test results of the source holders.\**
- *Dose records, (forward to RP Dosimetry for TLD issue).*

\* *Also applicable to Soil Moisture & Density Gauge Source test.*

**NOTE:** *All radworkers e.g. radiographers trainees, assistants and operators have been re-trained annually (The training shall include the radiation health and safety aspects relating to their work).*

- *Evidence of 3 monthly observations in accordance with Eskom Standard 238-40.*

7.6.4 Perform a plant walk-down to assess the potential risks:

- access points that will need to be locked, signposted, barricaded and guarded;
- lead shielding requirements;
- radiological conditions (radiation / contamination levels) in the work area, enroute to the work site and identify other areas / rooms / RP and plant equipment that may be affected due to streaming;
- scaffold requirements for shielding support.

7.6.5 Update the RT Work Plan Register, electronically, and assign the next appropriate number to the Work Plan.

7.6.6 Complete KFH-HP-148.

7.6.7 Prepare RT Maps using MSVISIO. Print in colour.

**NOTE:** *Using MS Visio and printing in colour is the preferred method, but hand drawings or drawings in MSWord will be acceptable.*

7.6.8 The RT Co-ordinator must ensure that all the signatures are obtained for KFH-HP-148, Section D.

7.6.9 RP Dosimetry and ALARA to complete Section C and sign KFH-HP-148.

**NOTE 1:** *Dosimetry staff authorised for the task, Issue Legal Dosimetry, may sign.*

**NOTE 2:** *ALARA staff authorised for the task, Perform ALARA RP Work Control Processes and High Risk Assessments, may sign.*

7.6.10 The RT Co-ordinator and the requesting Line Group must review the Work Plan for correctness. Resolve any issues and sign the KFH-HP-148, Section D.

**NOTE:** *RP Services staff authorised for the task, RP RT Co-ordinator, may sign.*

7.6.11 The appointed RP Senior Supervisor Plant or his/her delegate (RP controller) must perform an independent review of the Work Plan to ensure all areas are adequately barricaded, no inadvertent access can be gained to any RT area and shielding locations identified correctly before signing KFH-HP-148, Section D.

**NOTE:** *The RP Senior Supervisor Plant or his delegate, both appointed as RP Controllers, may sign.*

7.6.12 The RP SAP signs for the high risk activity, that risks have been identified and adequately mitigated and that the Radiation Protection Certificate (RPC) and RT plan is aligned.

7.6.13 The Outage Control Centre approval is only required if the Outage Critical Path is impacted.

**NOTE:** *The appropriate level to sign for the RT plans should be the Outage Execution Director or Outage Execution Manager on shift.*

7.6.14 Issue the Work Plan package to the duty Shift SRPA in RPOO and forward a copy to the Line Group and OCC Execution Management during outages.

## **7.7 Duties of the RP Controller (Duty SRPA) for Job Coverage**

7.7.1 Review the PTW system, if required.

7.7.2 Review the RT Work Plan.

- 7.7.3 Ensure that the RPC addresses the requirements identified in the RT Work Plan and is issued by a SAP (RP).
- 7.7.4 Delegate an authorised RPM to perform the Job Cover duties and issue source cubicle key.
- 7.7.5 Ensure that sufficient barrier guards as indicated on the Work Plans are available.
- 7.7.6 An RT pre-job briefing must be performed and documented using KFH-HP-149.
- 7.7.7 Upon job completion, review the completed radiological survey results and the check-off list for job coverage by the RPM. Confirm that the source has been returned to the proper cubicle or approved storage location. The X-ray machine must be stored in the designated area or signposted as per 5.3.2.

## **7.8 Duties of the RPM during Job Coverage for Radiography Sources**

- 7.8.1 The Duty SRPA to issue the cubicle key for the source to be used and the key to N040, or source cubicles in the NAB or Reactor Building.
- 7.8.2 Sign out source in logbook and lock the cubicle if the source is to be used outside a controlled zone or in a controlled zone other than the NAB or in the Reactor Building.
- 7.8.3 If the source is to be used inside the NAB or in the Reactor Building, lock the padlock to the source cubicle and proceed to the work location.
- 7.8.4 If the source is used for an extended period of time in the controlled zone, it must be transferred to the corresponding source cubicle number in the NAB or Reactor Building and the source logbook sheets must be updated.
- 7.8.5 Place the source in the corresponding cubicle number to the one in N040.
- 7.8.6 Enter details of source in logbook (KFH-HP-016) of that cubicle.
- 7.8.7 Place source details (source logbook sheet) on the outside of the cubicle door.
- 7.8.8 Lock cubicle and sign key back into the red zone key press in RPOO.
- 7.8.9 Key to be placed in reserved space, corresponding to the cubicle number.
- 7.8.10 Obtain the relevant checklist KFH-HP-143.
- 7.8.11 Make sure that all the steps are followed and sign off as checked. If a RPM is relieved during job coverage, he / she shall sign off the sheet and hand over to the next RPM who shall continue and sign off on completion.
- 7.8.12 Enter survey results on RadPro and forward completed checklist, KFH-HP-143, to the RP Controller.

**7.9 Duties of the RPM during Job Coverage using X-ray machines**

- 7.9.1 Before commencing the exposure, the RPM must ensure that there is nobody inside the exposure area.
- 7.9.2 The exposure must be terminated according to the correct termination procedures. Use of safety devices such as interlocks for exposure termination is not permitted.
- 7.9.3 Before entering the enclosed exposure facility after an exposure, the operator must make certain that the exposure has been terminated (unit switched off).
- 7.9.4 When the facility is not in use, the unit must be rendered inoperable by locking the control panel and removing the key.
- 7.9.5 Enter survey results on RadPro and forward completed checklist, KFH-HP-146, to the RP Controller.

**7.10 Duties of the RP Controller (Duty SRPA) for Radiography Source Removal from Site**

- 7.10.1 Complete PART C of KFH-HP-142, as applicable.
- 7.10.2 Update red zone key list.

**7.11 Duties of the RPM for Removal of the Radiography Source and or X-ray machine from Site**

- 7.11.1 Obtain the relevant KFH-HP-145 or KFH-HP-147 from the RP Controller.
- 7.11.2 Complete KFH-HP-145 or PART B of KFH-HP-147 as applicable.
- 7.11.3 Forward completed checklist, KFH-HP-145 or KFH-HP-147, as applicable, to the RP Controller.
- 7.11.4 Sign source out on logbook sheets.
- 7.11.5 Leave padlocks with keys on N040 cubicles.
- 7.11.6 If source(s) leave site, return the key and padlock to N040 or relevant cubicles.

**7.12 Emergency Actions for Non-retracted or Detached Radiography Source**

If, during radiography, the source becomes detached, does not retract, or is lost, the following actions shall be taken:

- 7.12.1 Make sure that all unessential personnel are evacuated from the area.
- 7.12.2 The RPM is to perform dose rate checks to establish and set up barriers at 25  $\mu\text{Sv/h}$ , or in accordance with zone definition, if practical. For non-control zones the barriers must be set up at < 2.5  $\mu\text{S/h}$ .

- 7.12.3 The RPM is to perform dose rate checks to establish the location of the radioactive source.
- 7.12.4 Make sure that the RPO (Radiography) remains in the vicinity (low dose rate area) to help prevent any personnel from coming near the source.
- 7.12.5 The RPM is to inform the duty SRPA (Ext. 4232) and both control rooms (Ext. 4122 Unit 1, and Ext. 4237 Unit 2). The Control Room must also make an announcement warning staff of the risk and to avoid the area.
- 7.12.6 No further action is to take place until a full ALARA review has been completed and a new RPC has been drawn up.
- 7.12.7 Notification of such an event shall be in accordance with KGH-010.
- 7.12.8 Refer to the RPO (Radiography) emergency procedures or Emergency Guide, Appendix 1, for guidance, if required.
- 7.12.9 Condition Report (CR) must be raised.

### **7.13 Approved Source Storage Areas**

- 7.13.1 During shift handovers or when film development takes an extended period of time, the source must be stored in an approved source store, or a RP Monitor must stay with the source.
- 7.13.2 Source storage areas must be approved by the RPO (Source Control) in writing.

## **8.0 ACCEPTANCE CRITERIA**

### **8.1 Leakage**

- 8.1.1 Removable activity (as determined by dry smear) must be less than 3,7 Bq/cm<sup>2</sup> over an area of 100 cm<sup>2</sup> for beta and gamma emitters (for Koeberg Nuclear Power Station sources).
- 8.1.2 For all off-site sources, the removable activity must be less than 0,37 Bq/cm<sup>2</sup> over an area of 300 cm<sup>2</sup> for beta and gamma emitters.

### **8.2 Checklists**

- 8.2.1 All completed checklists shall be forwarded to the Senior Supervisor for review.

## **9.0 RECORDS**

9.1 The following records are non-permanent records and must be retained in accordance with KSH-008.

- KFH-HP-015: Use of Radiography / Soil Moisture / Density Gauge Sources and X-ray Machine on Koeberg Site
- KFH-HP-022: Radiography / Soil Moisture & Density Gauge Source and X-ray Machine Arrival On Site
- KFH-HP-142: Controller Radiography Checklist
- KFH-HP-143: RPM Checklist for Gamma Radiography Job Coverage
- KFH-HP-144: RPM Checklist for Receipt of Gamma Radiography Source at Koeberg
- KFH-HP-145: RPM Checklist for Removal of Gamma Radiography Source at Koeberg
- KFH-HP-146: RPM Checklist for X-ray Radiography Job Coverage
- KFH-HP-147: RPM Checklist for Receipt and Removal of X-ray Radiography Machine at Koeberg
- KFH-HP-148: Work Plan for Gamma, X-ray Radiography and Soil Moisture & Density Gauge Source Test
- KFH-HP-149: Pre-job Briefing Gamma and X-ray Radiography

## **10.0 ATTACHMENTS**

Appendix 1 – Emergency Guide

Appendix 2 – Example of Warning Label on X-ray Machines

Appendix 3 – Justification

## APPENDIX 1

### EMERGENCY GUIDE

**THE SOURCE USER MUST HAVE HIS OWN PROCEDURES THAT CAN ALSO BE USED AFTER AN ALARA REVIEW.**

**THESE ACTIONS ARE ONLY A GUIDE TO WHAT COULD BE PERFORMED.**

**In the event where the winding gear is jammed and the source cannot be returned to the container the following actions shall be taken:**

- a) Shield radiation with lead sheeting or blocks, cement bag, or other suitable material. If practical, shielding is to be placed by remote means.
- b) Re-establish shielding material.
- c) Disconnect the winding cable connector from the locking mechanism on the container. RP and the source "owner" must attempt to return the isotope to the container by pulling the inner cable back through the container as quickly as possible, once again using sufficient shielding between the source and the individual. (Extreme care must be taken not to lose the source during this task).

**In the event that the pigtail becomes detached from the wind out cable, RP must take the following actions:**

- a) Ascertain the position of the source in the guide tube.
- b) Shield the source remotely, if possible.
- c) Disconnect the collimator or guide tube end piece.
- d) Attach the end of the guide tube to the emergency or transport container.
- e) Wind the source forward through the guide tube into the emergency or transport container.
- f) Do not make any further use of the container or winding gear until the RPO (Radiography) has inspected and cleared the equipment.

**In the event that the pigtail becomes detached in the collimator guide tube end piece, RP must take the following actions:**

- a) Shield radiation levels.
- b) Using all available extra shielding and specialised apparatus (i.e. mirrors, long handling tongs, etc.) remove attenuating material, and then lift the guide tube end piece, enabling the source to fall further down the guide tube.
- c) Ascertain the position of the source in the guide tube.
- d) Shield the source remotely, if possible.
- e) Disconnect the collimator or guide tube end piece.
- f) Attach the end of the guide tube to the emergency or transport container.
- g) Wind the source forward through the guide tube into the emergency or transport container.
- h) Do not make any further use of the container or winding gear until the RPO (Radiography) has inspected and cleared the equipment.



**APPENDIX 2**

**EXAMPLE OF WARNING LABEL ON X-RAY MACHINES  
(A4 size/yellow background)**



## **APPENDIX 3**

### **JUSTIFICATION**

#### **Revision 15**

1. Include CR 114834-001 NCR CA - Include the controls that needs to be in place to transport a radiography source in a lift.
2. Editorial changes.