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Module 16

EMISSIONS COMPLIANCE MONITORING

OBJECTIVES:

After completing this module you will be able to:

16.1 Define *Derived Emission Limits (DELs)*, and state which radionuclide groups are monitored in airborne and liquid effluent pathways. ⇔ *Page 1*

CRO 16.2 Define and state the purpose of *emissions compliance monitoring*, and briefly describe the methodology. ⇔ *Page 2*

CRO 16.3 Explain why unmonitored releases are a concern, and state <u>two</u> ways in which they can occur. ⇔ *Page 3*

16.4 Describe the Shift Supervisor's role in monitoring station emissions to ensure compliance with station emission targets. ⇔ *Page 3*

DERIVED EMISSION LIMITS

Limits on public dose from chronic (routine) plant emissions are recommended by the International Commission on Radiological Protection (ICRP), and approved for use in Canada by the Atomic Energy Control Board (AECB). Since public dose is not directly measured, emission limits are derived (calculated) from the public dose limits, using mathematical models for environmental dispersion of radionuclides and uptake by the human body. These derived emission limit (DEL) calculations must account for land use and population distribution around the station, local meteorological conditions, and other factors. The DEL calculations make conservative assumptions about proximity of the exposed individual to the station, shielding, exposure time, and source of food and drinking water.

Definition: *Derived Emission Limits (DELs)* are regulatory limits on chronic effluent emissions of various radionuclide groups, derived from the public dose limits. ⇔ *Obj. 16.1*

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The DELs specify the maximum quantity of each radionuclide or radionuclide group which can be released over a specified period of time. These site-specific limits are approved by the AECB. Restricting chronic emissions to a small fraction (typically 1%) of the DELs ensures that the total dose from all emissions does not exceed regulatory public dose limits for a continuously exposed member of the public. At some stations,*) emission targets are incorporated into the OP&P, and are treated as though they were regulatory limits.

* This is the case at PND, for example.

Although DELs can be calculated for each fission and activation product which might appear in an effluent, it is impractical to monitor for each and every radionuclide in airborne and liquid effluents. Therefore, limits are based on the most restrictive radionuclides in a few radionuclide groups. For example, the limit on airborne unidentified particulate contamination is based on Strontium-90, even though most airborne particulate contamination consists of less restrictive radionuclides. This results in a conservative limit on emissions for particulates in airborne effluent streams.

EMISSION COMPLIANCE MONITORING

Obj. 16.2 ⇔

Definition: *Emission Compliance Monitoring* is the measurement of radioactive, environmental emissions to demonstrate compliance with the DELs and station emission targets approved by the AECB for the site.

Radionuclide Groups Monitored

1) Tritium

Tritium is produced in a CANDU reactor by neutron activation of the deuterium in the heavy water coolant and moderator, and is monitored in both liquid and airborne effluent streams.

2) Particulates and Liquid Effluent Contamination

Radioactive particulates in airborne and liquid effluents consist of fission products and activated corrosion products. Unidentified particulate activity in the effluent streams is reported as though it were all the most restrictive possible radionuclide in the group (strontium-90 in airborne effluent and cesium-134 in liquid effluent). The results are usually expressed in gross beta-gamma curies.

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3) Radioiodines

Radioiodines are fission products which are normally present in the heat transport system at concentrations which vary with the number and severity of fuel defects. Escape from the heat transport system through leaks or directly from defective fuel during fuel handling activities can give rise to airborne radioiodine. Radioiodines are monitored in the airborne effluent streams.

4) Noble Gases

The radioactive noble gases may be fission products (eg, isotopes of Krypton and Xenon) or activation products (eg, Argon-41, produced from neutron activation of Argon-40, normally present in air). Radioactive noble gases escape to building atmosphere in the same ways as the radioiodines. The tight heat transport boundary and closed cycle air drying systems with small exhaust flows, allow some noble gas activity to decay prior to release to the environment. Noble gases released to the environment are an external radiation hazard. The gamma dose rate is the limiting factor for noble gases released. Noble gas releases are monitored in airborne effluent streams, and results are expressed in gamma-curie-MeV.

Method Of Compliance Monitoring

Airborne and liquid emissions are measured by continuous, on-line sampling of the effluent streams. The composite samples are taken to the lab for counting. The exception is noble gases, which are not collected (except in the case of grab samples). Instead, the sample stream is counted continuously by an on-line detector, and the total accumulated count is read out periodically.

Unmonitored Releases

⇔ *Obj. 16.3*

Releases must be restricted to pathways which are monitored. If releases occur via an unmonitored pathway, or while monitoring equipment is out of service on designed effluent streams, then their magnitude must be estimated. However, such estimates are after the fact, and do not facilitate effective control action.

Shift Supervisor's Role In Compliance Monitoring

⇔ *Obj. 16.4*

The SS's role in monitoring station emissions is in the surveillance of operations to ensure compliance with the DELs and to minimize emissions. The SS's role can be broken down into three main areas:

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At some stations, ump-out approvals are delegated to a lower authority.

1. The SS approves planned releases such as active liquid waste pump-outs,*) to ensure that they will not violate the station's emission targets.

2. The SS reviews O&M activities to ensure that unmonitored releases will not result. In particular, the SS reviews and approves maintenance on stack monitoring equipment, ensuring that alternative means of assessing emissions are deployed while the stack monitor is removed from service.

3. The SS reviews compliance monitoring results, specifies corrective action in the event of abnormally high emissions, and reports any releases which have exceeded the station emission targets.

SUMMARY OF THE KEY CONCEPTS

- Derived emission limits are regulatory limits on routine emissions of designated radionuclide groups, derived from the public dose limits. The combined dose from all emissions must not exceed the regulatory public dose limits.

- Emission compliance monitoring is the measurement of radioactive emissions to demonstrate compliance with the AECB approved station emissions targets.

- Airborne effluent streams are monitored for:

  — tritium
  — particulates
  — radioiodine
  — radioactive noble gases.

- Liquid effluent streams are monitored for:

  — tritium
  — gross beta-gamma from particulate, and dissolved radioiodines and noble gases

- Unmonitored releases can occur via an unmonitored pathway, or via a monitored pathway while monitoring equipment is out of service. Because their magnitudes can only be estimated after the fact, effective control action is impossible.

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- The Shift Supervisor's compliance monitoring role includes:
  - — reviewing planned releases
  - — ensuring there are no unmonitored releases
  - — reviewing and approving stack monitor maintenance
  - — reviewing compliance monitoring results
  - — specifying corrective action for any abnormal results
  - — reporting and documenting any releases exceeding emission targets

ASSIGNMENT

1. Carefully prepare detailed answers to the Module 16 learning objectives.
2. Describe the compliance monitoring program at your station, and its impact on the key results areas of the nuclear safety program listed in Module 2.
3. Explain the relationship between public dose limits, derived emission limits, and the station's emission targets.

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Date: January 1997