Radiological Aspects of Accelerators

Overhead 13.1

Objectives:

- Identify the general characteristics of accelerators.
- Identify the types of particles accelerated.
- Identify the two basic types of accelerators.
- Identify uses for accelerators.
- Define prompt radiation.
- Identify prompt radiation sources.

Radiological Aspects of Accelerators (cont.)

Overhead 13.2

Objectives:

- **Define radioactivation.**
- **Explain how contaminated material differs from activated material with regard to radiological concerns.**
- **Identify activation sources.**

Radiological Aspects of Accelerators (cont.)

Overhead 13.3

Objectives:

- **Identify engineered and administrative controls at accelerator facilities.**
- **Identify the special radiological concern and recommended instrument for each type of accelerator radiation survey.**

Accelerated Particles

- Electrons
- Protons
- Nuclei of various elements

Types of Accelerators

- Linear accelerators:
  - Van de Graaff
  - Cockcrott-Waltons
- Circular-path accelerators:
  - Cyclotrons
  - Betatrons
  - Synchrotrons
- Colliders

Uses for Accelerators

- Basic research
- Production of radioisotopes
- Generation of bremsstrahlung for radiography
- Induction of fusion
- Pumping for lasers
- Detoxification of hazardous waste
- Production of synchrotron radiation

Radiological Concerns

- **Prompt radiation:**
  - **Primary beam**
  - **Secondary beam**
  - **Skyshine**
  - **Electromagnetic radiation**
  - **Neutrons**
  - **Muons**

Radiological Concerns
(cont.)

- Residual radioactivity:
  - Contaminated materials
  - Activated materials
- Ancillary sources

Controls

- Engineered controls
- Administrative controls

Engineered Controls

- Passive:
  - Barriers
  - Shielding
- Active:
  - Status lights
  - Alarms
  - Interlocks
  - Scram buttons

Administrative Controls

- Signs/postings
- Search and secure procedures
- Controlled access procedures
- Configuration control procedures
- Radiological Work Permits (RWPs)

Monitoring

- May be complicated (unique conditions)
- Prompt radiation fields
- Environmental
- Personnel

Assessment Techniques

Overhead 14.1

Objectives:

- **Describe the difference between structured and unstructured assessments.**
- **Describe the difference between vertical and horizontal reviews.**
- **List the documents needed in order to perform a radiological assessment.**

Assessment Techniques
(cont.)

Overhead 14.2

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Objectives:

- Define the term assessment.
- Describe how to evaluate a contractor assessment program using DOE's Technical Safety Appraisal approach.
- Describe the desired characteristics of performance goals.
- List five performance indicators used in assessing Radiation Protection Program effectiveness.

Assessment Types

- Unstructured
- Structured techniques:
  - Vertical review
  - Horizontal review

Vertical versus Horizontal Reviews

- Vertical:
  - Narrow scope
  - Detailed assessment
- Horizontal:
  - Broad scope
  - Less detailed assessment

Documents Needed for Assessment

- 10 CFR Part 835
- Site Radiation Protection Program
- DOE-STD-1098-98 Radiological Control
- Other federal regulations
- Applicable DOE orders
- State regulations
- DOE Implementation Guides

Documents Needed for an Assessment (cont.)

- Site DOE contract
- Site commitments
- Site reports (deficiency, occurrence)
- Site-Specific RadCon Manual
- Approved exemptions
- Peer/industry group standards/recommendations

Assessing Radiological Performance

- Assessments include:
  - Internal audits
  - Inspections
  - Reviews
  - Investigations
  - Self-assessments

Assessment Approach

- Assessments:
  - Management
  - Operational
  - Quality assurance
- Functional areas:
  - Performance objectives
  - Criteria for each performance objective

Radiation Protection Deficiencies

- Managers should regard them as opportunities.
- Work practices should be continually scrutinized.
- Number of deficiencies does not measure overall quality.

Critiques

- Formal process to obtain pertinent facts
- Follow radiological incident
- Quickly establish facts in chronological order
- Focus on "lessons learned," not on blame
- Complement the Occurrence Reporting and Processing of DOE Order 232.1A

Radiation Protection Program Performance

Overhead 14.11

Goals should be:

- **Established, approved, and maintained by contractor senior site executive**
- **Measurable**
- **Achievable**
- **Auditable**
- **Challenging**
- **Meaningful in promoting improvement**

Radiation Protection Program Performance (cont.)

- Developed by those performing work
- Reviewed at least annually
- Revised as appropriate

Performance Indicators

- Evaluate Radiation Protection Program performance.
- “What gets measured, gets done.”

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Planning and Conducting Assessments

Overhead 15.1

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Objectives:

- **List 10 of the 19 elements of a Radiation Protection Program.**
- **Identify five deficiencies in a Radiation Protection Program that point to the need for an assessment.**
- **Describe the preparations needed to conduct a Radiation Protection Program assessment.**

Planning and Conducting Assessments (cont.)

Overhead 15.2

DOE-HDBK-1141-2001

Objectives:

- **Describe how to conduct a Radiation Protection Program assessment.**
- **Describe two qualifying conditions for a follow-up assessment.**
- **Describe what actions should be taken when assessments indicate marginal radiological control performance.**

Elements of a Radiation Protection Program

- Organization and administration
- Personnel training and qualification
- Quality assurance
- ALARA
- Radiological work control
- Posting and labeling
- Radioactive material control

Elements of a Radiation Protection Program (cont.)

- Radiation-generating devices
- Entry control
- Contamination control
- Instrumentation and alarms
- Monitoring
- Dosimetry
- Respiratory protection

Elements of a Radiation Protection Program (cont.)

- Facility-specific features
- Radioactive waste management
- Emergency response
- Records
- Assessments/performance indicators

Indicators: Assessment Is Needed

- Exceeding administrative dose levels or regulatory limits
- Loss of radioactive material control
- Unmonitored/excessive release to environment
- Excessive number of skin contamination incidents
- Uptakes of radioactive material
- Excessive number of radiological incidents

Indicators: Assessment Is Needed (cont.)

- Inadequate training
- Ineffective work control systems
- Incomplete or inaccurate:
  - Radiological surveys
  - Records

Assessment Preparation

- Review operating history
- Examine previous assessment reports
- Collect input from person(s) assessed
- Determine applicability of industry issues
- Review policies and procedures
- Assemble regulations and guidance documents
- Prepare an assessment plan

Operating History

- Occurrence reports
- Radiological deficiency reports
- Violations/citations
- Facility design changes

Previous Assessments

- DNFSB Recommendations
- Self-assessments
- Corporate quality assurance
- External audit group

Input from Person(s) to be Assessed

- Management
- Radiological Control Manager
- Radiological Control Organization's "customers"

Industry Issues

- Emerging technical issues
- Application of best industry standards

Policies and Procedures

- Operating procedures
- Radiological control policies

Regulations and Guidance Documents

- Federal
- State
- Site
- Industry/peer group

Assessment Plan

- Identify elements to assess.
- Generate specific questions.
- Develop record sheet.
- Allocate time (backup plan).
- Leave unscheduled time.

Types of Assessments

- Announced
- Unannounced

Assessment Methods

- Document reviews
- Personnel interviews
- Field observations

Recommended Approach

- Review upper-tier procedures
- Conduct short site tour
- Interview key persons
- Conduct follow-up actions

Key Interviews

- Radiological Control Manager
- Radiological Control Supervisors
- Radiological Control Technical Leads
- Radiological Control Technicians

Key Interviews (cont.)

- Radiological Control Organization's "customers"
- DOE Representatives
- Facility Manager

Post-Assessment Actions

- Publish findings
- Receive responses
- Accept/reject/modify responses
- Develop action tracking list
- Publish status report

Post-Assessment Actions (cont.)

- Maintain file of open action items.
- Verify closure of action items.
- Evaluate adequacy of actions taken:
  - Root cause identified?
  - Follow-up assessments needed?

Follow-up Assessments

Qualifying conditions:

- **Widespread problem**
- **Recurring problem**

Marginal Radiological Performance

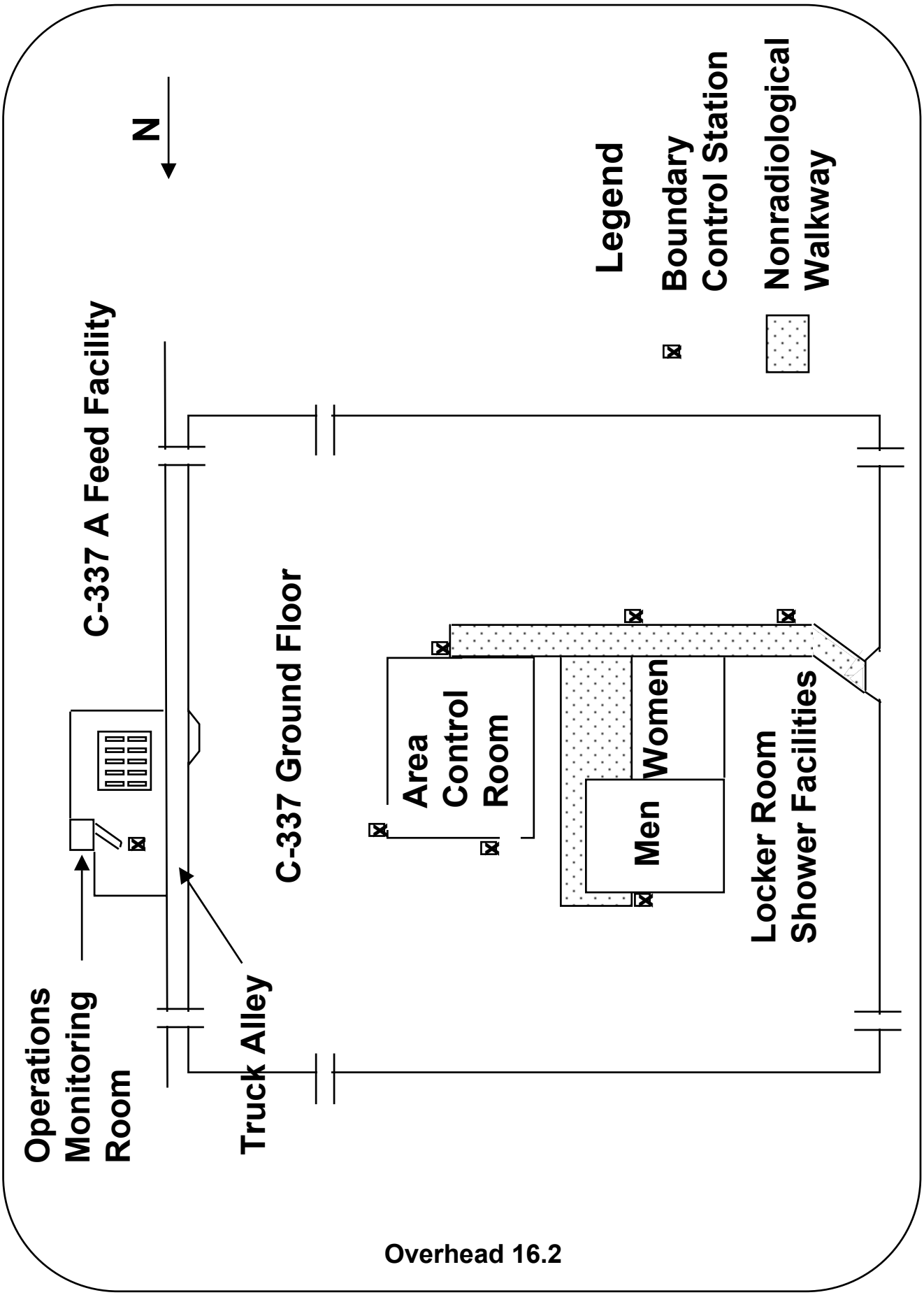
Initial actions should include:

- More direct line supervision in the work space
- Curtailment of work schedules
- Addition of extra radiological control personnel
- Conduct of additional training

Case Studies

Objectives:

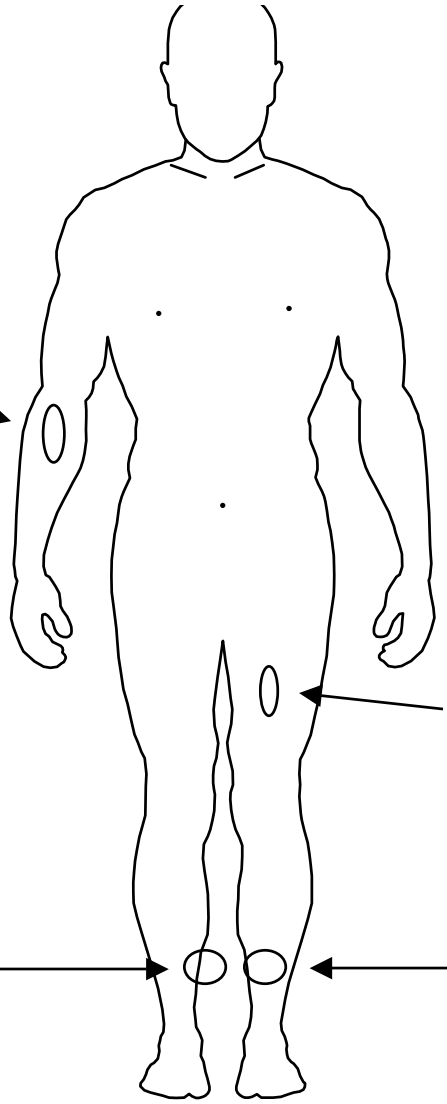
- Describe causes of radiological incidents.
- Identify primary cause and contributing causes of radiological incidents.
- Describe effective corrective actions.



OT 16.2

Overhead 16.2

Pre and Post Decontamination Skin Contamination
(dpm per probe area; beta/gamma)



Employee No. 1

6,500 Pre

< 1,000 Post

4,500 Pre

< 1,000 Post

2,750 Pre

<1,000 Post

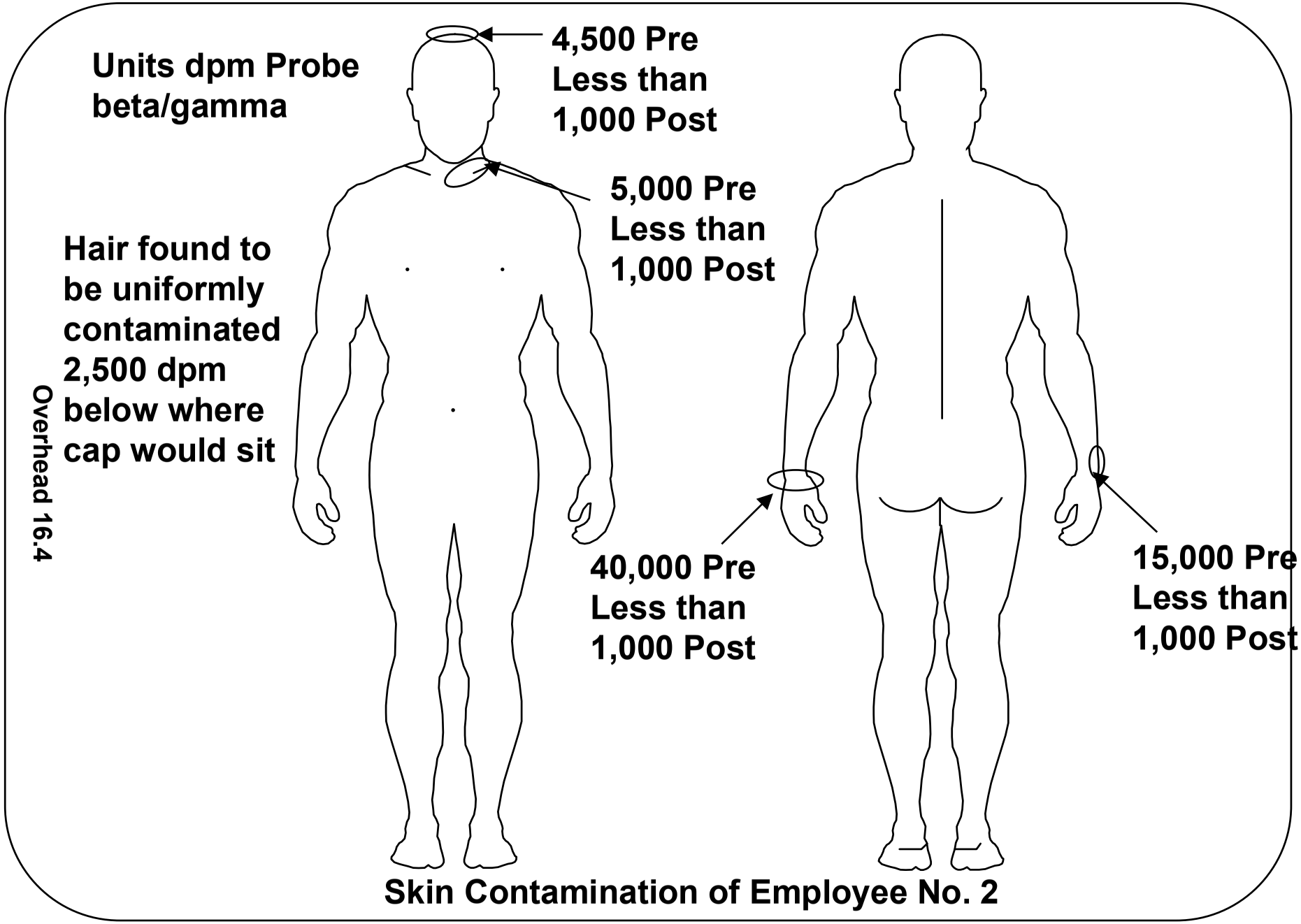
2,750 Pre

<1,000 Post

Overhead 16.3

DOE-HDBK-1141-2001

OT 16.3



Overhead 16.4

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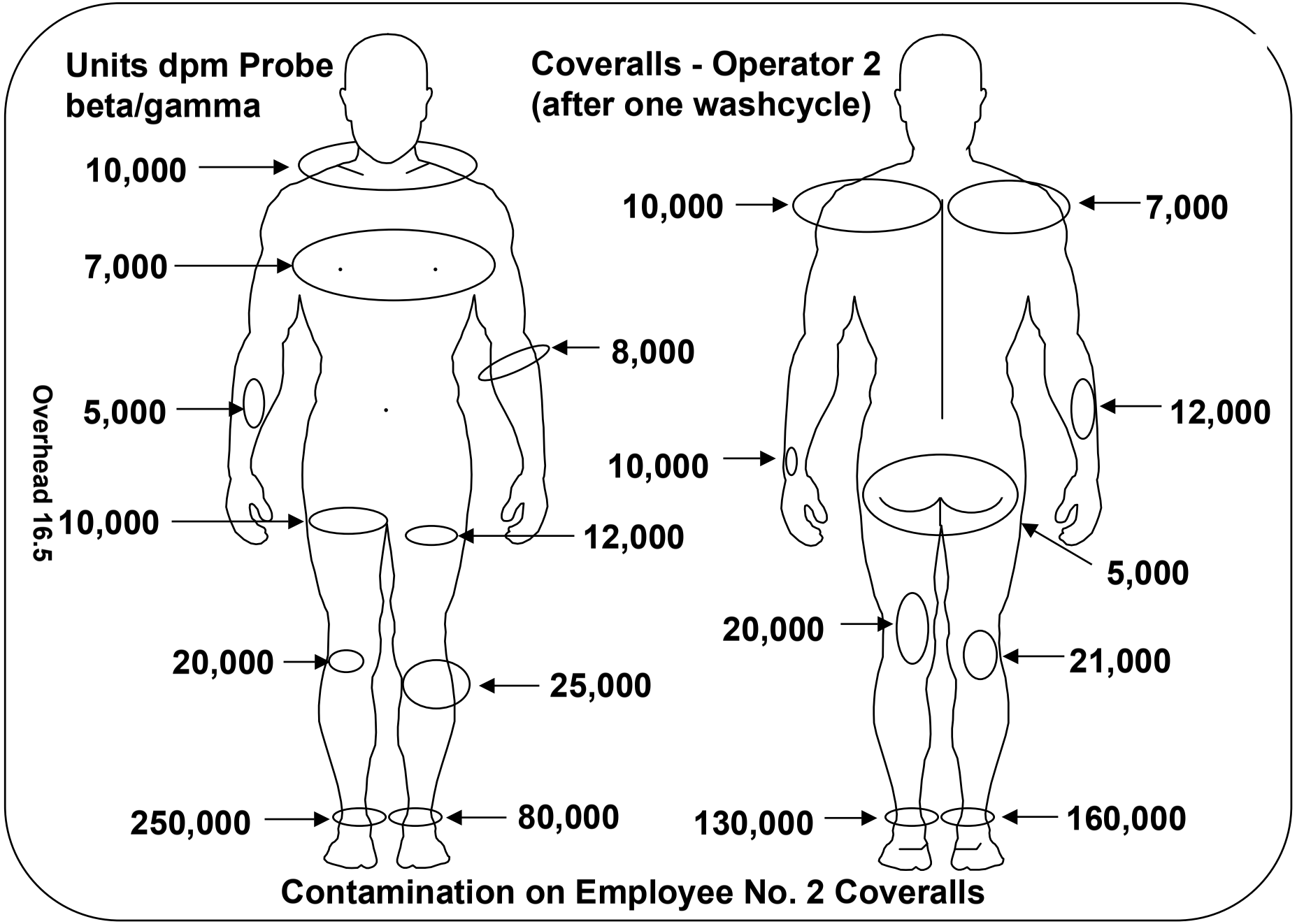
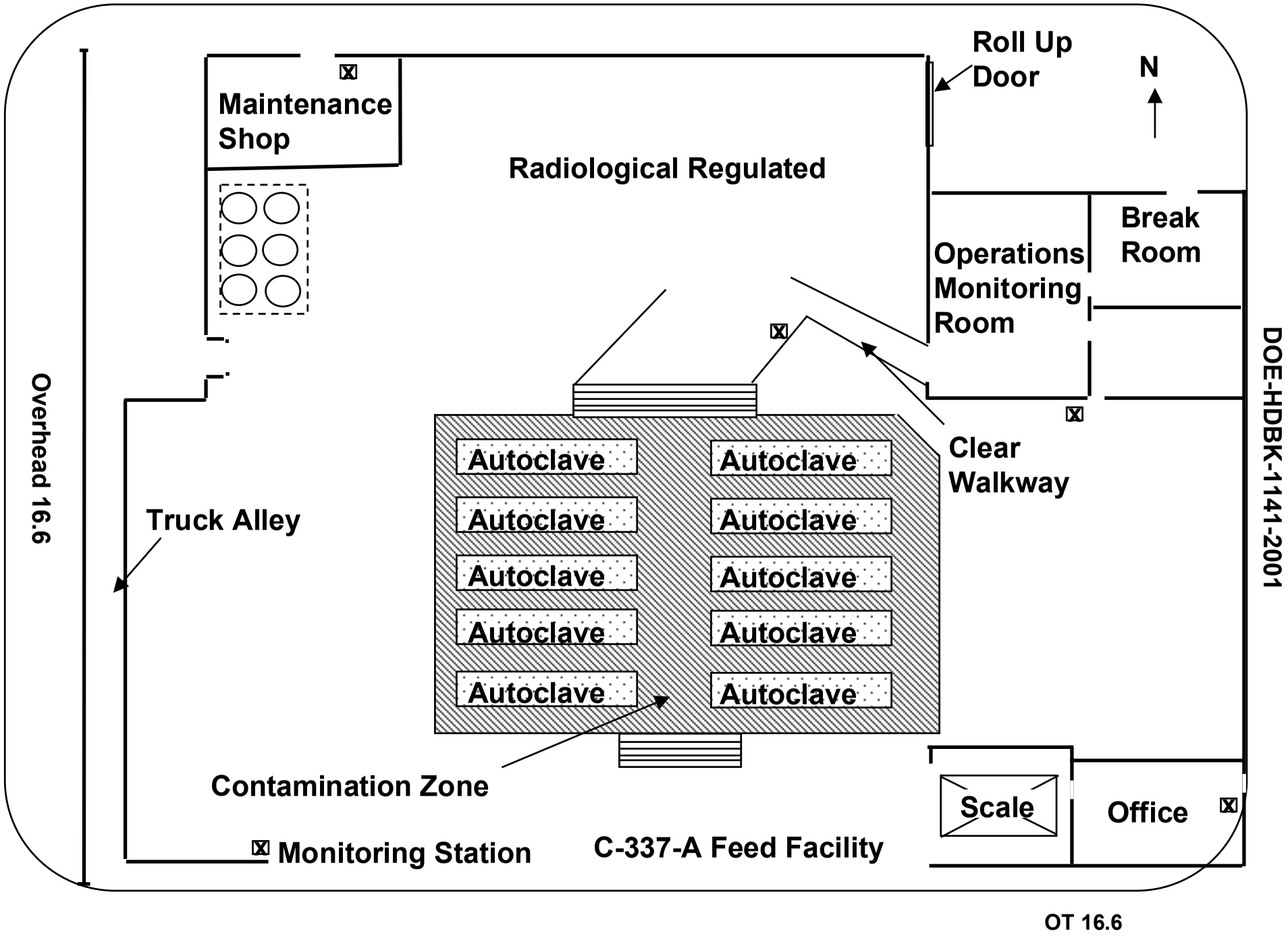
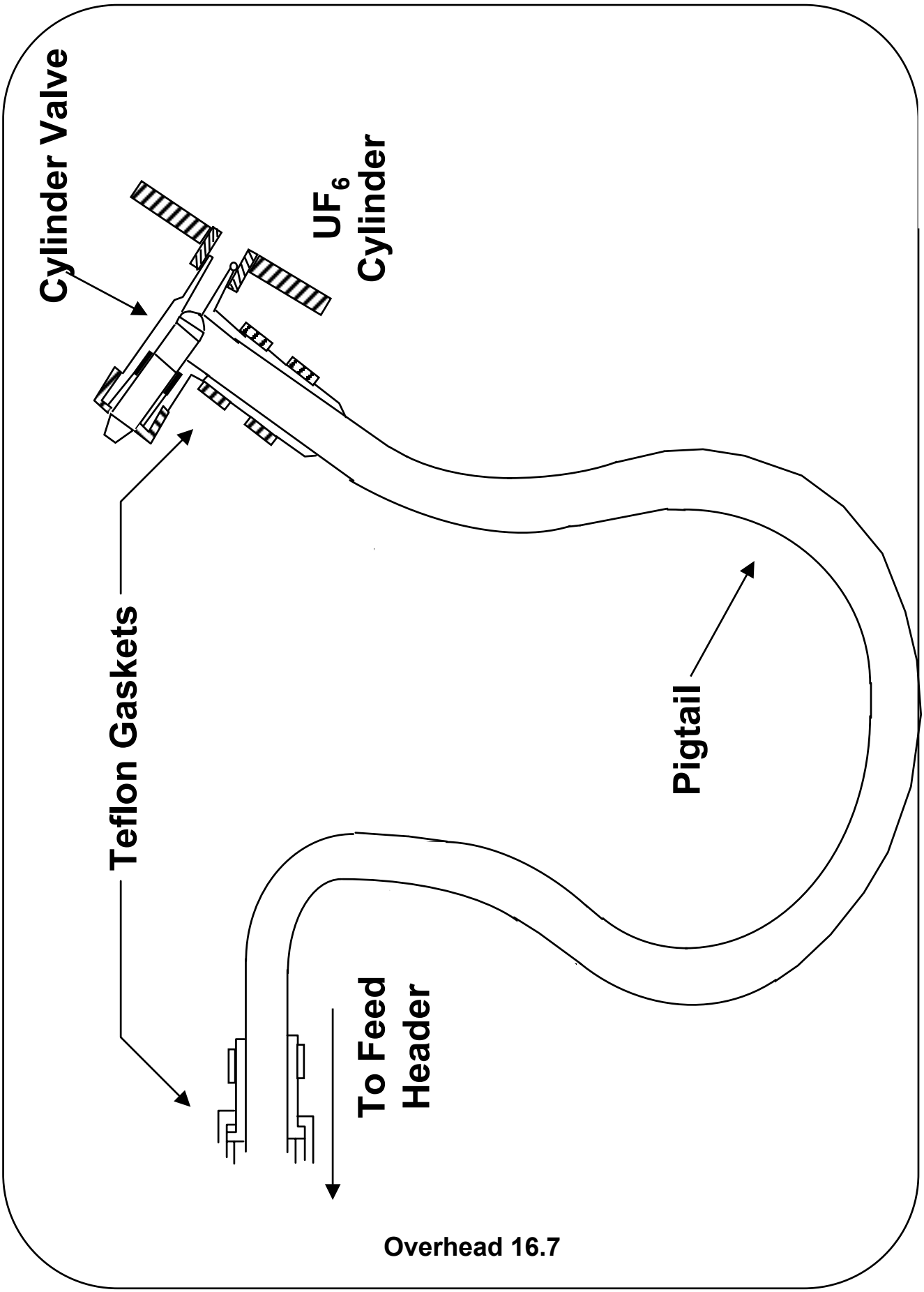
OT 16.4


Units dpm Probe
beta/gamma
10,000
7,000
8,000
5,000
10,000
12,000
20,000
25,000
250,000
80,000
Coveralls - Operator 2
(after one washcycle)
10,000
7,000
12,000
10,000
5,000
20,000
21,000
130,000
160,000
Contamination on Employee No. 2 Coveralls


Roll Up
Door
N
Maintenance
Shop
Radiological Regulated
Break
Room
Operations
Monitoring
Room
Overhead 16.6
DOE-HDBK-1141-2001
Clear
Walkway
Truck Alley
Autoclave
Autoclave
Autoclave
Autoclave
Autoclave
Autoclave
Autoclave
Autoclave
Autoclave
Autoclave
Contamination Zone
Scale
Office
Monitoring Station
C-337-A Feed Facility
OT 16.6


Cylinder Valve
UF_6 Cylinder
Teflon Gaskets
Pigtail
To Feed Header
Overhead 16.7
OT 16.7

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Review and Critique of Findings and Improved Writing of Findings

Overhead 17.1

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Objectives:

- List the three finding categories and describe how to separate surface issues from underlying substantial issues.
- List three of the five priority groupings for assessment findings.
- Identify the three steps needed to write an appropriate finding.
- List three suggestions for effective presentation of findings and concerns.

Finding Categories

- Surface:
  - Minor issues
  - Easy to correct
- Substantial:
  - More significant issues
  - Ease in correcting varies
- Organizational:
  - Programmatic issues
  - Difficult to correct

Priority Groupings

In decreasing order of priority:

- **Imminent danger**
- **Not imminent, but potential danger**
- **Violations of regulations, laws, and orders**
- **Adverse public opinion**
- **Performance and effectiveness issues**

Writing Findings

- List requirement
- State observation
- State concern

Compliance-Based Versus Performance-Based Evaluations

Objectives:

- Define compliance-based audits.
- Define performance-based assessments.
- Describe the four key elements of the assessment process.
- Describe the advantage of planning for an assessment.
- Identify the preferred type of checklist.

Bases

- Compliance-based audits
- Performance-based assessments

Assessment Process

- Planning
- Performance
- Reporting
- Post-assessment actions:
  - Response evaluation
  - Followup
  - Closeout

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Field Exercise Guidelines

Objectives:

- **Demonstrate applied field assessment techniques.**
- **Present a finding to the class after return from the field.**

Assessor Conduct

- Set a good example
- Remember safety:
  - Personal
  - Facility
  - Radiological

After Return from the Field

- Write up 1 finding (prescribed format):
  - Observe 1½-2 minute time limit
  - Coordinate with group members
- Present to class tomorrow morning
- Site personnel should be invited to exit briefing

Presentation Findings

- List the requirement
- State what was observed
- State the concern