

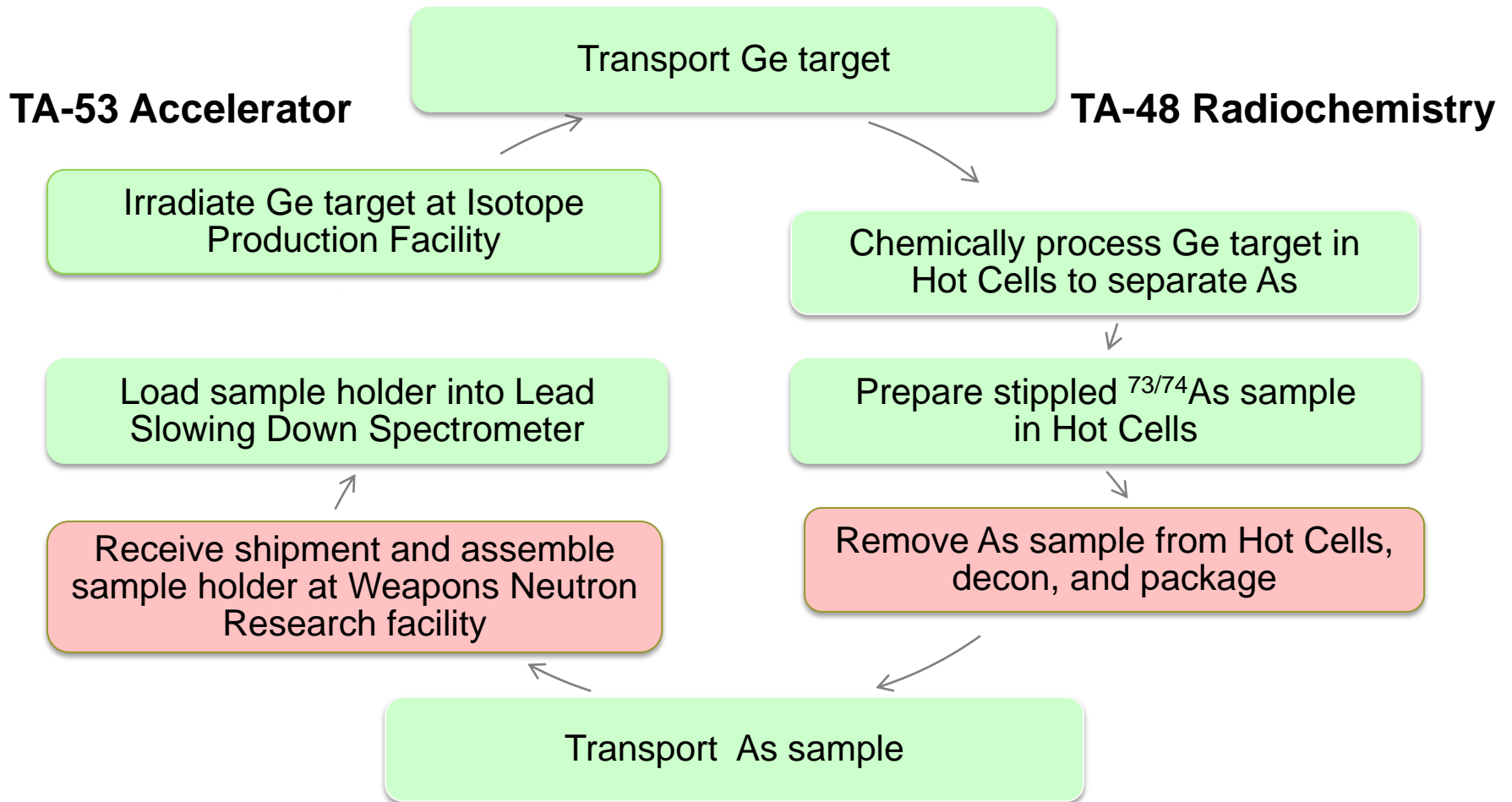
Extremity Dose Event

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The Event

- **On July 24, 2009, a chemist performed hands-on work at the Radiochemistry Facility (RC-1), TA-48 to remove a sample from a hot cell containing Arsenic (As)-73 and As-74 for shipment to the Los Alamos Neutron Science Center (LANSCE) at TA-53.**
- **On July 24, 2009, a researcher and a post doctoral research associate performed hands-on work with the sample at LANSCE, TA-53.**
- **The sample's beta dose rate was higher than expected resulting in exposures to the skin and extremities of the chemist, the researcher, and the Post Doc.**

Event Overview



Work Activity

Purpose

- Measure the $^{74}\text{As}^{(n,p)}$ cross section at low incident neutron energies using the lead slowing-down spectrometer (LSDS) at LANSCE

Sample characteristics

- ^{73}As (625 mCi, 80 d, 100% EC, 53 keV γ @10%)
- ^{74}As (383 mCi, 18 d, 37% EC, 34% β^- , 29% β^+ , and γ rays up to 1.5 MeV)

Isotope separation and target preparation

- Completed at TA-48 RC-1 hot cells

Removal from Hot Cells, decon, and packaging

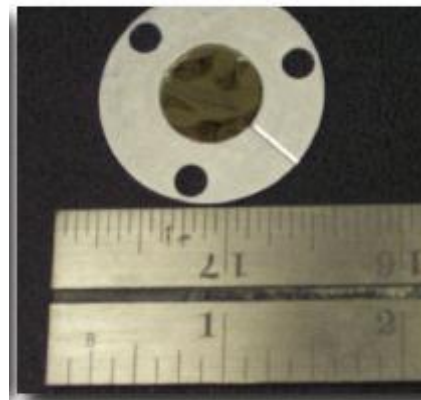
- Completed at TA-48 RC-1

Sample mounting and cross section measurements

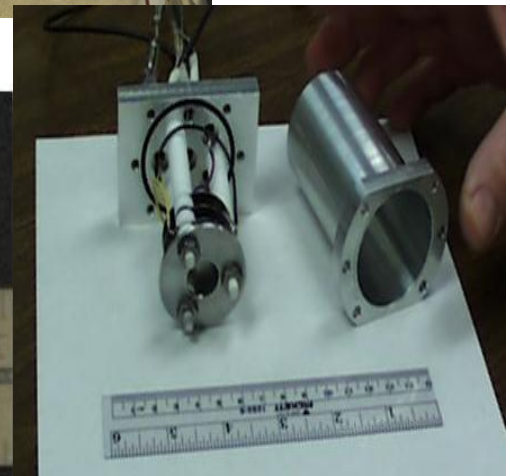
- Conducted at TA-53 LANSCE WNR



RC-1 Hot Cell Sample Access Port



Target Disc



LSDS Detector Assembly

Timeline

- Event - Sample handled at both facilities 07/24/09
- Potential extremity dose notifications 08/04/09
- Critique and OPRS Categorization 08/06/09
- ORPS Notification Posted 08/10/09
- Determined NTS reportable/draft report developed 09/01/09
- Initial dose assessment completed 09/16/09
- Causal analysis needed additional work; extension request 09/17/09
- Event re-categorized to ORPS Significance-level 2 09/28/09
- Office of Enforcement Investigation 10/09/09
- NTS report submitted 10/19/09
- ORPS report Finalized 11/13/09
- Letter response to OE follow-up questions 12/09/09
- Additional sample characterization report issued 01/19/09
- Final dose assessment completed 01/26/10
- Investigation Report 08/18/10
- Enforcement Conference 09/30/10
- PNOV Issued 04/15/11
- Final Order 06/07/11

Immediate actions/compensatory measures

- **Formal Dose Assessments initiated**
- **Workers restricted from further exposure**
- **Similar activities suspended at both facilities**
- **Extent of condition review across LANL**
- **Preliminary lessons learned**
 - Line and facility organizations
 - Radiation Protection (RP) staff
 - β hazard identification, analysis, & control
 - Adherence to radiological work permit (RWP)
- **Reporting & investigation launched**
- **Planning initiated for re-design of experiment**

Dose Assessment

- Required for chemist, researcher, and post doc
- RP assigned multidiscipline team to reconstruct doses
- Based on interviews, mock-ups, time/motion studies, detailed measurements

- **Result: higher than expected extremity exposures to 3 workers in short timeframe**

Worker	Skin beta dose (rem, r/l)	Extremity gamma dose (rem, r/l)	Other CY09 extremity dose (rem)	Total CY09 extremity dose* (rem)
Chemist	16.3 / 8.1	0.16 / 0.07	0.324	16.78
Researcher	25.3 / 6.3	0.30 / 0.07	0.046	25.65
Post Doc	18.5 / 1.9	0.30 / 0.03	0.006	18.81

* comparable to 50 rem/year dose limit for extremities

Event causes and additional factors

Work Control/Hazard Analysis and Control

- Work planning and work control documents not specific to atypical source
- Atypical source (directional radiation) not subjected to sufficient individual hazard analysis
- hazard not adequately controlled
- Work control documents not sufficiently followed
- Missed opportunities to apply in-place change control processes
- Work paused on several occasions, but not stopped

Radiation Protection Processes

- Procedures weak and not executed for proper hazard characterization & control
- RCT knowledge / skills / abilities for hazard characterization & control not focused on beta hazard

Corrective Action Summary

Local Corrective Actions

- Improved technical & safety review of user experiments
 - Increased SME & Peer review
 - Restrictions on handling high-rad sources
 - Required dose calculations
- Revised and strengthened work control documents and renewed emphasis on integrated work teams & pre-job briefs
- Updated Facility Radiation Protection (RP) Strategies & Facility RP Improvement Plans
- Re-designed the experiment & communicated lessons learned

Institutional Corrective Actions

- Created extremity exposure thresholds in institutional requirements to drive work control rigor
- Focused on work planning & execution in quarterly RP self-assessments
- Strengthening technical basis and beta monitoring requirements in Health Physics Operations (RP-1) procedures
- Established Integrated Work Management team for RP & Improved P&T communications
- Established RP-1 activity turnover process & Developed RP-1 Training Improvement Plan
 - 1st effort: continuing education on beta hazard monitoring, analysis, & control

Enforcement Response

LANL Response was Comprehensive and Thorough

- Senior Management involvement through-out
- Excellent Organizational Teaming and Cooperation through-out
- Senior ORPS Investigator assigned to perform the investigation
- Deputy Associate Director of Chemistry, Life, and Earth Sciences; and the Chemistry Division Leader led a team to develop corrective actions and map them to causes

Initial Response

- LANL Enforcement coordinator (EC) notified Management, Subject Matter Experts (SME), and Legal Counsel (phone calls and emails)
- Meeting to kick off preparation
 - LANL EC presented enforcement process & draft agenda for investigation opening conference
 - Senior managers, Legal Counsel , SMEs & LANL ECs discussed and decided what would be presented and who would present at the opening conference for the investigation

Lessons Learned

- Initially we did not have a senior ORPS investigator to perform the investigation for this complex event
- Having a senior investigator resulted in a thorough and effective causal analysis and corrective action plan

Enforcement Response

Cost Segregation - LANL EC called the Controller

- Separate cost code established and sent out to all affected managers with instructions
- Senior managers emailed and reminded at meetings
- Costs were verified and managed

Investigation Preparation and Conduction

- Meetings for dry run opening conference presentations by senior managers
 - LANL Enforcement Coordination Office (ECO) coordinated, reviewed first drafts, & collected comments during dry runs; Deputy Director led meetings
- Document request to affected organizations
 - Affected organizations gathered documents, LANL ECs coordinated, assembled, and reviewed documents, & sent to Office of Enforcement

Lessons Learned: Needed electronic and paper copies with personal information redacted

Lessons Learned: Needed to assign a POC from affected organizations for evenings and weekends

- Dry run walk downs of work areas with affected managers and workers
 - ECO scheduled and led
- Legal/ECO presentation to interviewees on process, expectations, and rights

Enforcement Response

Investigation Preparation and Conduction (continued)

- LANL ECO developed investigation schedule with DOE Office of Enforcement
 - Scheduled interviewees on meeting maker
- LANL ECO managed the investigation interview process
 - In-briefs and out-briefs – kept log of additional information requested
- LANL ECO provided end of day out-briefs to management during the investigation
- LANL ECO maintained good communication with Los Alamos Site Office (LASO)

Enforcement Conference Preparation

- Meetings for dry run presentations by senior managers and Legal Counsel
 - LANL ECO coordinated, reviewed first drafts, & collected comments during dry runs; Deputy Director led meetings
 - LANL Director opened and closed the enforcement conference
 - Senior Management in Chemistry, Radiation Protection, Environmental Safety and Health, and Operations presented updates at the enforcement conference

Enforcement Response

Significance and Mitigation Factors conveyed by Legal Counsel at Enforcement Conference

- Legal Counsel provided a wrap-up presentation reaffirming that DOE may refrain from issuing a civil penalty or a notice of violation when:
 - The incident was promptly identified and reported to DOE as well as other sites.
 - The violation was not willful.
 - We took prompt and appropriate corrective action to address the incident.
 - We have taken and are taking appropriate remedial actions to prevent recurrence of the incident and the underlying conditions that caused it.

Senior Management in their presentations at the Enforcement Conference also supported this position.

- Legal Counsel also pointed out what was right:
 - Cited requirements where we were compliant
 - Public was not at risk
 - Controls that were in place likely prevented the exposure from exceeding regulatory limits
 - Recent data indicated that our corrective actions were effective

Overall we believe this process worked very well

Enforcement Summary

We received:

- Three Severity Level II and one Severity Level III violation to 10 CFR 835
 - Violations considered “high safety significance”
- No mitigation for timely self-identification and reporting because of self-disclosing nature of event

We felt that our handling of the event and our response was thorough:

- Detailed and thorough investigation and ensuing corrective actions resulted in 50% mitigation of base penalty for each of the Severity Level II Violations
 - Base civil penalty of \$165,000 reduced to \$82,500
- OE stated they “recognize the Director’s and Senior Manager’s commitment to safety” at the enforcement conference

Laying Foundation for Success

LANL Program Strengths:

- LANL Deputy Director has ongoing communications with the DOE Office of Enforcement Acting Director
- LANL ECO promptly discusses issues of concern with the Office of Enforcement and LASO
- LANL ECO holds weekly meetings and has frequent discussions with LASO Representatives
- LANL ECO initiated a new NTS Report closure review process that includes LANL Management and LASO Representation
- LANL Institutional Management Review Board performs oversight of NTS reports and actions

Questions

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