Criticality Safety and Non Destructive Assay 'A K-25 Love Story?'

Roger W. Bartholomay

(URS-Professional Solutions)

&

Dr. Brandon P. Rasmussen

(Restoration Services Incorporated)

INTRODUCTION

- **Four specific situations will be discussed**
  - Surge Tanks
  - G-17 Valves
  - Line Recorder Manifold Cabinets
  - Operations Floor Level Evacuation Line
- **Reasons for the need of new or additional NDA varied depending upon the situation**
  - As a result the plan for NDA measurements varied
- **Outcome, results, and benefits to the K-25 D&D Project will be discussed**

Surge Tanks

Surge Tanks

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☆Data

- ☆ Between 4 and 8 foot diameter tanks
- ☆ 15 to 26 feet long
- ☆ 1980s neutron and gamma based NDA results indicated 17 tanks ranging from ~350 g to ~9,000 g ^{235}U
- ☆ Most of them were dry, before and during planned movement, but 3 smaller diameter tanks contained Millers Fluorinated Lubricant

☆Problem

- ☆ 12 of the tanks would be single parameter type operations throughout the lifetime of activities
- ☆ Single parameter type operations involves more controls at both the Criticality Safety level and at the Technical Safety Requirements level: → more cost longer schedule for completion

Surge Tank Being Moved

Surge Tank Plan

- **NDA group provide contemporary measurement results for each tank**
  - Used visual inspection results to more accurately model the configuration of deposition within a tank
  - High purity Germanium (HpGe) detector with the In-Situ Object Counting System (ISOCS)
- **NCS revise analysis to account for contemporary NDA**
  - When dealing with an individual tank where the inventory of uranium can not possibly change, additional NDA results can be used to lower the mass upset levels evaluated
  - SCALE and MCNP models were used to specifically determine critical configurations for tank movement

Surge Tank Results

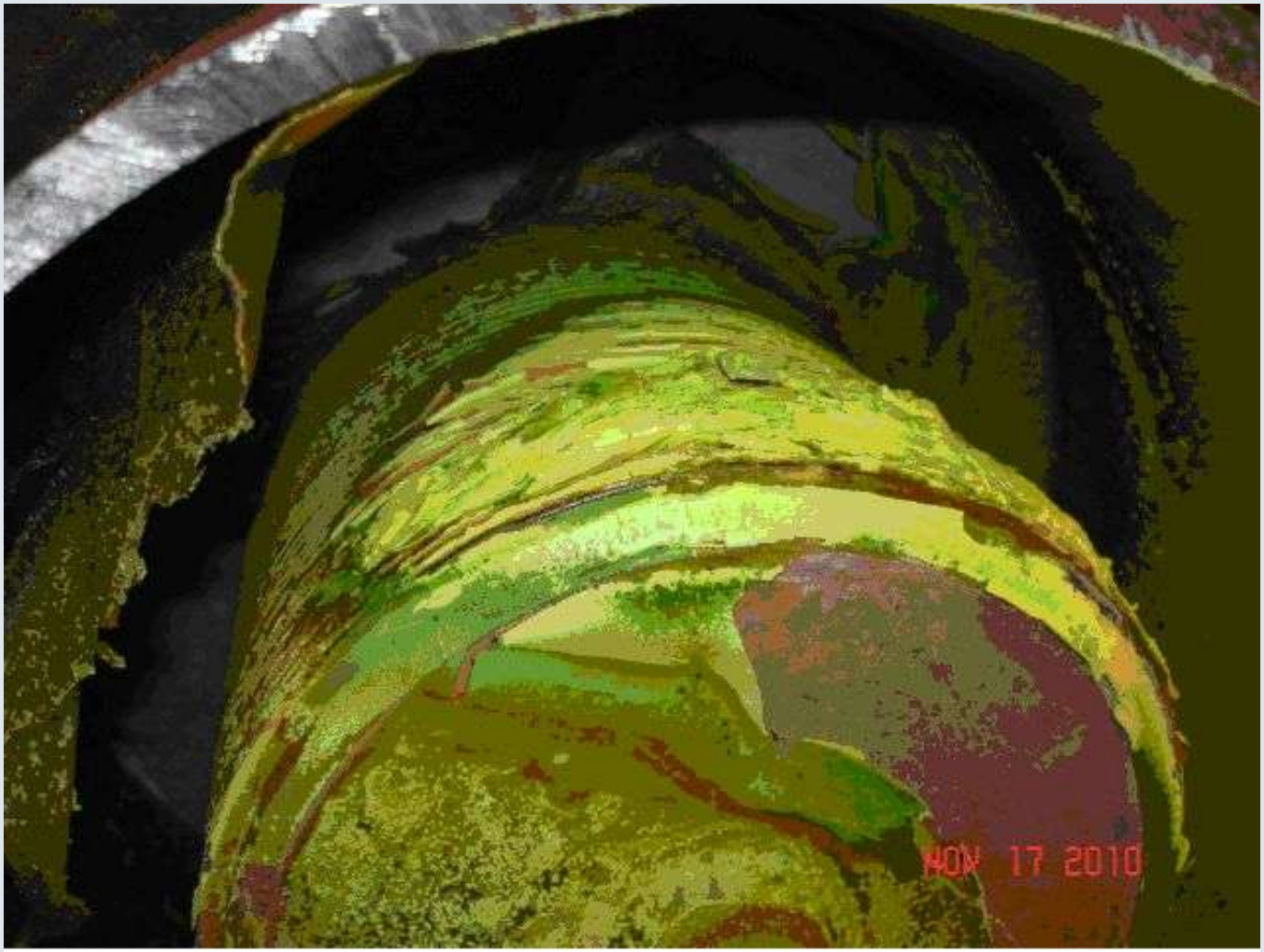
- **For smaller diameter surge tanks the contemporary NDA results at +2σ averaged over 1000 g less than historical 1980s NDA results**
- **For the bounding large diameter surge tank, the contemporary NDA allowed the normal condition ^{235}U mass to drop by 2300 g**
- **The NCSE for movement of the surge tanks was revised**
  - For 5 of the 17 tanks a criticality accident was shown to be incredible during movement
  - Only 8 of the 17 tanks could not be shown to comply with the DOE requirements pertaining to the Double Contingency Principle (DCP) during movement, all 17 tanks could be shown to comply with DCP during mining
- **The NCSE for mining (uranium removal) was revised**
  - For higher mass large diameter tanks, the number of administrative controls was decreased by 1/2
  - For lower mass small diameter tanks, the number of administrative controls was decreased by 2/3
- **To date, 12 tanks have been mined: contemporary NDA results have proven quite accurate**

G-17 Valve (4 inch diameter)

G-17 Valves

- **Data**
  - ~ 5000 G-17 valves existed in K-25
  - Range from 3 to 14 inch diameter
- **Problem**
  - Early ex-situ NDA results on two G-17 valves revealed a significant underestimation with existing characterization technique (NaI/HMS-4)
  - Issue for both removal and movement of valves as well as for future criticality incredible determinations for those left in the building

G-17 Valve: Problem



G-17 Valves: Plan

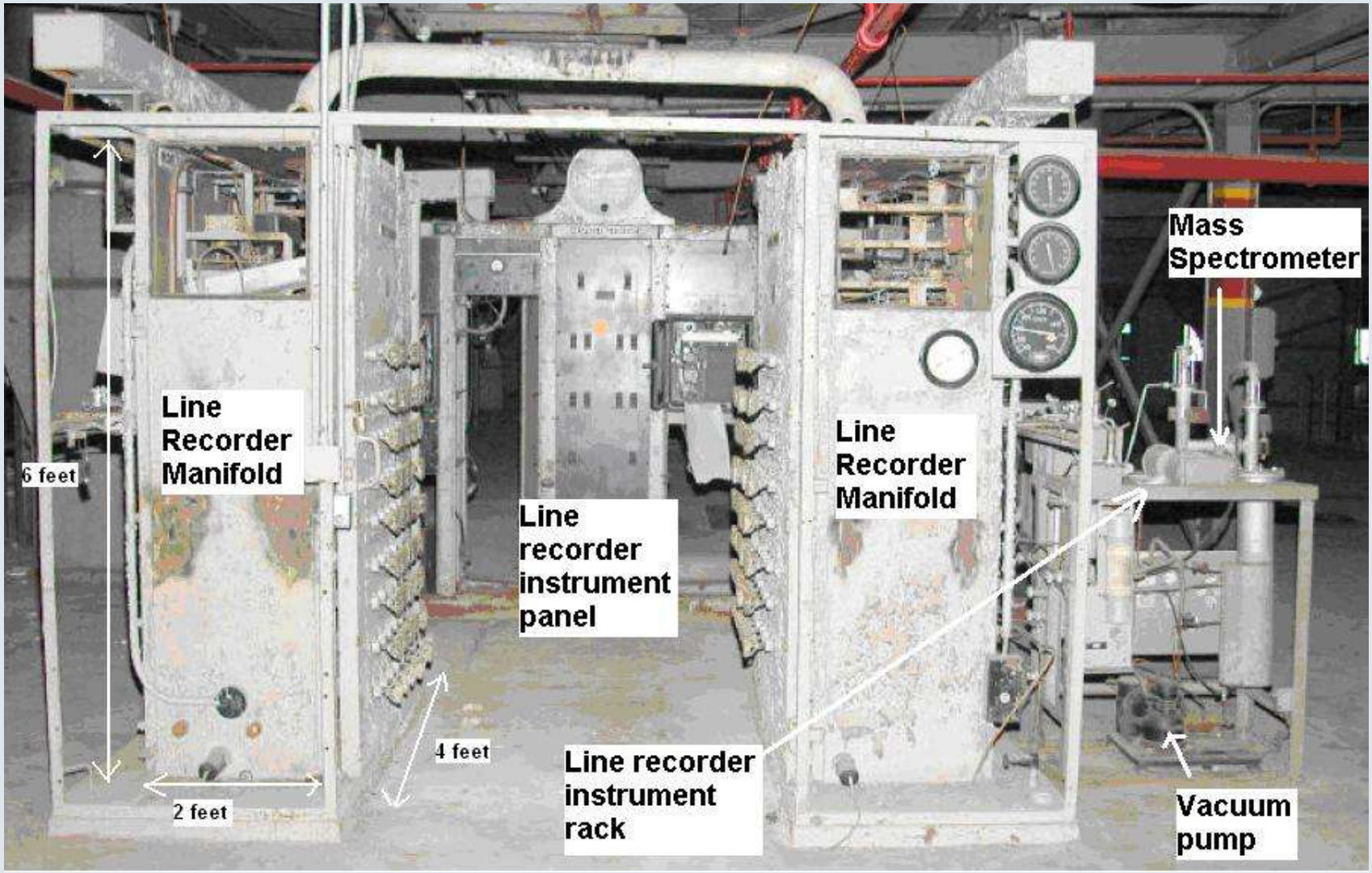
- ☆Assemble a team to review the inventory of G-17 valves
- ☆Select a representative population to perform in-situ measurements with HpGe/ISOCS then remove and measure in Uranium Neutron Counting System (UNCS)
- ☆Also analyze with further NDA measurements the two upset valves during segmentation and mining
- ☆Use the results to develop a more conservative NaI/HMS-4 measurement methodology

Uranium Neutron Counting System

G-17 Valves: Results

- ☆An overhaul of the NaI/HMS-4 measurement methodology was needed and implemented
- ☆All existing HMS-4 results in the Criticality Incredible Data Management System (CIDMS) were updated with a bias correction factor
- ☆Valves near the EMWMF burial criteria were measured a second time
- ☆In the over 3 years since implementation (~2000 valves), no additional cases of significant underestimation with HMS-4 have occurred

Line Recorder Manifold Cabinets (LRMCs)



Line Recorder Manifold Cabinets

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☆Problem

- ☆ 1980s NDA did not characterize
- ☆ Operations floor inaccessible
- ☆ Systematic characterization plan for achieving Criticality Incredible and burial failed (two LRMCs > 350 g ^{235}U were identified)

☆Plan

- ☆ Remove nearby vent/ductwork in operations floor
- ☆ Build scaffolding from pipe gallery level catwalk
- ☆ Lift HpGe/ISOCS detector up through hole and measure
- ☆ Large Standoffs were combated through longer count times and helped by low background conditions on operations floor

Line Recorder Manifold Cabinets

Line Recorder Manifold Cabinets

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☆Results

- ☆Each of the Line Recorder Manifold Cabinets were measured with qualified NDA instrumentation
- ☆Only one exceeded burial ground ^{235}U mass criteria
- ☆Enabled the demolition of the East Wing and North End of the building to be performed under a criticality incredible determination

UF-6 Evacuation Line

UF-6 Evacuation Line

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☆Description

- ☆Four inch diameter line between K-1423 and K-27
- ☆Process knowledge indicates rarely used
- ☆No ties to the K-25 building process gas system

☆Problem

- ☆It is on the operations floor of East Wing; therefore, inaccessible since 2006.
- ☆No existing characterization to approve it for demolition or for burial at Environmental Management Waste Management Facility (EMWMF)

UF-6 Evacuation Line

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☆ Plan

- ☆ Goal was to show the pipe contains less than 10 g ^{235}U per foot of pipe (EMWMF burial criteria for 4 inch diameter pipe)
- ☆ Measure directly each foot outside K-25 in the tie line areas
- ☆ Set up HpGe/ISOCS at the tops of certain stairwells and measure as much length of pipe as can fit in the field of view
- ☆ Use man lifts from outside the building at various locations to aim HpGe/ISOCS at the pipe
- ☆ Low background on operations floor level, combined with longer count times would hopefully offset some of the large stand-off distances (10 to 50 feet)

☆ Results

- ☆ Approximately 38% of the length of the pipe in the building was systematically characterized through these methods
- ☆ Each measurement result indicated the average g/ft of pipe was less than half the EMWMF burial criteria
- ☆ NCS was able to claim when combined with process knowledge that this pipe would not lead to a criticality during either demolition or disposal at EMWMF

Conclusion

- ☆NDA has been a key element of characterization in order to prepare K-25 for demolition and disposal
- ☆A number of situations have stretched NDA techniques outside normal comfort zones
- ☆Over 90% of the massive K-25 Building has been demolished and disposed at EMWMF