Technology Safety Data Sheet
Remotely Operated Nondestructive Examination System

Section 1: Technology Identity

Technology Name(s):	Emergency Contact:
Remotely Operated Nondestructive Examination System DOE OST TMS # 3094	Allan F. Pardini Telephone: (509) 375-2525
Manufacturer's Name and Address:	**Information Contact:**
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Section 2: Technology Pictures

Figure 1: View of Control Console and Scanning Head on Mock-up Tank in Laboratory in Stevens Building.

Figure 2: View of RONDE Crawler/scanning Bridge on Mock-up Tank Wall.

Figure 3: View of Tank Mockup with the Deployment Sled in Foreground on the Tank Bottom.

Figure 4: View of the Mockup Tank Interior Illustrating the Knuckle Region for Examination.

Section 3: Technology Description

The Remotely Operated Nondestructive Examination System (RONDE) was developed to examine the knuckle region of the primary tank of the Hanford's Double-shell Tanks (DSTs) storing radiological wastes. The knuckle region begins at the construction weld on the vertical portion of the tank and extends to the transition weld on the bottom of the tank. Examination of the knuckle region of the DSTs is one of the key elements in ensuring the integrity of the tanks, and is not accessible using conventional measurement techniques. The RONDE uses an advanced signal processing method known as Tandem Synthetic Aperture Focusing Technique (T-SAFT) to introduce ultrasonic sound waves above the knuckle region where access is readily achieved and examine the knuckle region below, primarily for cracks. The T-SAFT technique provides detection and location method for cracks in the knuckle region.

The RONDE system is composed of three main components: RONDE magnetic wheel crawler and scanning bridge, electronics enclosure, and control station. Approximately 100 feet of multi-conductor cable connects the crawler/scanning assembly to the tank-top electronic enclosure. Approximately 425 feet cable bundle connects the electronic enclosure to the control station. This 425 feet connection consists of a small multi-conductor cable for the joystick and a single fiber optic cable with two fibers for data and control of the remote computer. The control station provides the computing hardware necessary to perform data acquisition and data analysis.

The tank-top electronics enclosure is located near the entrance riser to the tank annulus. Housed in the enclosure are electronics for driving the magnetic wheel crawler, electronics for driving the scanning bridge mechanisms, and the ultrasonic pulser/receiver for inspection of the tank knuckle.
The crawler/bridge scanning assembly consists of two components: the motorized magnetic crawler and the X and Y scanning bridge system. The crawler, using permanent magnetic wheels, maneuvers the scanning bridge on the tank wall. The four wheels are on independent suspension. The crawler uses skid steering for turning and is operated by a remote joystick. The joystick cable is 425 feet long. Two independent DC motors power the wheels. The crawler weighs 20 pounds and can accommodate a payload of 40 pounds. The scanning bridge controls the X and Y movement of the transducers. It hangs freely from the crawler like a pendulum. This permits the crawler to turn in any direction and transverse the wall at any desired angle. The bridge weighs 28.6 pounds. It uses high precision linear worm drive assemblies for positioning.

Operation of the RONDE system is from a remote trailer. Nondestructive Evaluation (NDE) operators view monitors that provide camera views of the RONDE during normal operation on the knuckle region. The RONDE crawler and scanning bridge is deployed manually through an existing annulus riser. The crawler/scanning bridge is driven off the deployment platform and maneuvered down the tank wall to the knuckle region of the DST annulus. The crawler is positioned for the start of the scanning sequence. After the first foot of the knuckle is evaluated, the crawler is then driven forward (circumferentially) around the tank and the next foot of the knuckle is examined. When the examination of the wall is complete, the RONDE system is then driven back on the platform, positioned at the opening of the riser, and manually extracted from the annulus.

Section 4: Safety Hazards

Hazard Category:

(Adapted from Appendix A to MIL-STD-882D, February 10, 2000, Department of Defense Standard Practice for System Safety.)

- 4 - Could result in death or permanent total disability
- 3 - Could result in permanent partial disability or injuries or occupational illness that may result in hospitalization of at least three persons
- 2 - Could result in injury or occupational illness resulting in one or more lost work days
- 1 - Could result in injury or illness not resulting in a lost work day
- N/A - Is not applicable to this technology and poses no appreciable risk

A. Buried Utilities, Drums, and Tanks	Hazard Rating: N/A

Buried utilities, drums, and tanks are not applicable to this technology and pose no appreciable risk.

B. Chemical (Reactive, Corrosive, Pyrophoric, etc)	Hazard Rating: 1

There is a potential for contact with a corrosive liquid if the tank leaks and the unit contacts the liquid.

C. Confined Space	Hazard Rating: 1

Measurement is made in the tank annular space. If the annular space is ventilated, ensure that ventilation is operating and the atmosphere meets the requirements to prevent workers from opening the riser and, therefore, from potential exposure to vapors or airborne radiological contamination.

D. Electrical	Hazard Rating: 2

Source voltage is 110 volts AC. A Ground Fault Circuit Interrupter (GFCI) should be used. Low voltage direct current (DC) is supplied to the RONDE via the umbilical and is bundled with the water line used to make the measurement. Consider running a grounding lead from the tank-top equipment enclosure to the tank.

E. Explosives	Hazard Rating: N/A

Explosives are not applicable to this technology and pose no appreciable risk.

F. Fire Protection	Hazard Rating: N/A
There are no fire protection requirements imposed by this technology. Site-specific fire protection programs should be followed.	
G. Gas Cylinders	**Hazard Rating: N/A**
Gas cylinders are not applicable to this technology and pose no appreciable risk.	
H. Ladders/Platforms	**Hazard Rating: N/A**
Ladders and platforms are not applicable to this technology and pose no appreciable risk.	
I. Lockout/Tagout	**Hazard Rating: 2**
There is 110 volts AC and 24 volts DC powering the tank-top instrument enclosure and the crawler/X-Y bridge. Consider not powering the unit during insertion and removal from the tank annular space. Follow lockout/tagout procedures during maintenance and repair.	
J. Mechanical Hazards	**Hazard Rating: 2**
There are potential pinch points on the lifting bale and between the sled and the riser during insertion and removal. Consider a removal pin between the pan and the lifting bale that would reduce pinch points that can be removed during insertion and removal. The unit contains powerful magnetic wheels and caution should be used to avoid pinching the hands and fingers if crawler is placed near ferromagnetic material. Wear gloves during these functions.	
K. Moving Vehicles	**Hazard Rating: N/A**
Moving vehicles are not applicable to this technology and pose no appreciable risk.	
L. Overhead Hazards	**Hazard Rating: N/A**
Overhead hazards are not applicable to this technology and pose no appreciable risk.	
M. Pressure Hazards	**Hazard Rating: N/A**
Pressure hazards are not applicable to this technology and poses no appreciable risk.	
N. Slips/Trips/Falls	**Hazard Rating: 1**
The cables from the remote trailer to the tank-top electronics enclosure and the umbilical from the tank-top instrument enclosure to the sensor head should be managed to minimize this tripping hazard.	
O. Suspended Loads	**Hazard Rating: N/A**
Suspended loads are not applicable to this technology and pose no appreciable risk.	

P. Trenching/Excavation	Hazard Rating: N/A
Trenching/excavation are not applicable to this technology and pose no appreciable risk.	

Section 5: Health Hazards

A. Inhalation	Hazard Rating: 2
Measurement is made in the tank's annular space. If the annular space is ventilated, ensure that ventilation is operating and atmosphere meets requirements, to prevent workers from opening the riser and, therefore, from potential exposure to vapors and airborne radiological contamination.	

B. Skin Absorption	Hazard Rating: 1
There is a potential for contact with a corrosive liquid if the tank leaks and the unit contacts the liquid. Wear level of personal protective equipment (PPE) required.	

C. Noise	Hazard Rating: N/A
This technology does not produce noise.	

D. Heat Stress/Cold Stress	Hazard Rating: 2
Weather conditions need to be considered during the summer and winter months, and the use of PPE during operation may cause heat or cold stress. Manage worker duty-time.	

E. Ergonomics	Hazard Rating: 2
There is bending, lifting and carrying the unit before insertion. There is bending and lifting during insertion of the unit into the annular space of the tank, and bending and lifting during removal of the sled from the tank. Use proper work position, do not hyperextend the arms, and seek help when handling heavy loads. Consider using a mechanical hoist or inertial brake on pulley for umbilical handling when unit is operating in the annulus.	

F. Ionizing Radiation	Hazard Rating: 1
Site-specific for the use of the instrument. Refer to site-specific radiation worker permit for details and follow procedures.	

G. Non-ionizing Radiation	Hazard Rating: N/A
Non-ionizing radiation is not applicable to this technology and poses no appreciable risk.	

H. Biological Hazards	Hazard Rating: N/A
Biological hazards are not applicable to this technology and pose no appreciable risk.	

I. Other	Hazard Rating: N/A

None

Section 6: Phase Analysis

A. Construction/Start-up

- Movement of equipment to work location and placement of the tank-top equipment enclosure and spool piece will involve the use of a forklift. Use only trained operators.
- When opening the riser, follow site-specific procedures and use required PPE to protect workers from potential vapors or airborne radiological contamination.
- Follow lockout/tagout procedures when connecting cables. Power the unit when located in the tank annulus and do not handle the assembly when energized to avoid the potential of electrical shock.
- There are potential pinch points on the lifting bale and between the sled and the riser during insertion of the assembly and removal of the sled. The unit contains powerful magnetic wheels and caution should be used to avoid pinching the hands and fingers if crawler is placed near ferromagnetic material. Wear gloves during these operations.
- There is bending, lifting, and carrying the unit before insertion. There is bending and lifting during insertion of the assembly into the annular space of the tank, and bending and lifting during removal of the sled from the tank after the crawler/scanning bridge is deployed. Maintain proper work position, do not hyperextend the arms, and seek help when handling heavy loads or use a mechanical hoist.

B. Operation

Operation of the system involves calibration of the unit, positioning the unit on the wall, and performing the measurements. There may be worker fatigue if operation continues for an extended period.

C. Maintenance (Emergency and Routine)

- Removal of the unit from the riser involves bending and lifting during removal of the sled from the tank. Maintain proper work position, do not hyperextend the arms, and seek help when handling heavy loads or use a mechanical hoist.
- Follow site-specific requirements when checking for contamination and use required PPE.
- Remove power and follow Lockout/tagout procedures when unit is being maintained or parts replaced.

D. Shutdown (Emergency and Routine)

- Removal of the unit from the riser involves bending and lifting during insertion of the sled to the tank and removal of the assembly from the riser. Maintain proper work position, do not hyperextend the arms, and seek help when handling heavy loads or use a mechanical hoist. Maintain proper work position, do not hyperextend the arms, and seek help when handling heavy loads or use a mechanical hoist.
- Shut off power and follow lockout/tagout procedures when disconnecting cables. Do not handle the assembly when energized to avoid the potential of electrical shock.
- Check for contamination following site-specific procedures and use required PPE.
- When closing the riser, follow site-specific procedures and use required PPE to protect workers from potential vapors or airborne radiological contamination.
- Emergency shut down: shut off power.

E. Decontamination/Decommissioning

- Survey equipment to determine level of contamination.
- If contaminated use PPE and decontaminate and dispose of equipment following site-specific requirements.

Section 7: Worker Protection Measures

A. Exposure Monitoring

Follow site-specific programs for the area where the instrument will be deployed.

B. Worker Training

- Lockout/tagout
- HAZWOPER
- Job Specific procedures
- Certified NDE Operator
- Employees entering and working in DOE facility radiological areas may also require additional training, and must participate in the radiological monitoring identified in the Radiation Worker Permit. The level of additional training depends on the characteristics of the area entered (level of radiation or contamination) and the task performed. Training levels include Orientation Training, General Employee Radiological Training (GERT), Radiological Worker I Training (RWI), and Radiological Worker II Training (RWII).

C. Medical Surveillance

There are no additional requirements to the site-specific requirements.

D. Engineering Controls

- Consider an inertial break on the cable to the RONDE deployment sled and on handling the umbilical.
- Consider the use of a mechanical hoist for insertion and removal of the unit.

E. Administrative Controls

There are no additional controls recommended to those in the site Radiological work permit.

F. Personal Protective Equipment

- Gloves
- Safety shoes
- Site-specific requirements

Section 8: Emergency Preparedness

Site-specific requirements should be met.

Section 9: Comments, Lessons Learned, & Special Considerations

None

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