PALO VERDE NUCLEAR GENERATING STATION

TITLE

Course Title: FREEZE SEAL INSTALLATION
Lesson Number: NMH06-00-XC-001-000
Lesson Title: NITROGEN FREEZE SEAL
Duration: 20 HOURS
Author: MITCHELL WALTER

Revision Author: _____ Revision Date: _____

Technical Review: FREDLUND JIM Teach Approval: _____

INITIATING DOCUMENTS

TASK # 2515, 2530, 2545, 2560, 2575,2590

TOPIC REQUIREMENTS

N/A

CONTENT REFERENCES

PROCEDURE 33MT-9ZZ02
ELEC POWER RESEARCH INSTITUTE, SEPT 17, 1986
FREEZE TECHNOLOGY INTERNATIONAL, SEPT 15, 1987
CRDR 9-5-0158 LER No 50-244, GINNA, LER NO 50-269 OCONEE, LER NO. 50-458 RIVER BEND, SER NO 3-91 WATERFORD, LER NO 317 CALVERT CLIFF, LER NO 50-352 LIMERICK

MATERIALS REQUIRED

WHITE BOARD
FREEZE SEAL EQUIPMENT
TRANSPARENCIES
33MT-9ZZ02 PROCEDURE
OVER HEAD PROJECTOR
DEWARS
MOVIES

Transparencies

NMH06-00-XC-001-TO01
NMH06-00-XC-001-TO02
NMH06-00-XC-001-TO03
NMH06-00-XC-001-TO04
NMH06-00-XC-001-TO05
NMH06-00-XC-001-TO06
NMH06-00-XC-001-TO07
NMH06-00-XC-001-TO08
NMH06-00-XC-001-TO09
NMH06-00-XC-001-TO10
NMH06-00-XC-001-TO11
NMH06-00-XC-001-TO12
NMH06-00-XC-001-TO13
NMH06-00-XC-001-TO14
NMH06-00-XC-001-TO15
NMH06-00-XC-001-TO16
NMH06-00-XC-001-TO17
NMH06-00-XC-001-TO18
NMH06-00-XC-001-TO19
NMH06-00-XC-001-TO20
NMH06-00-XC-001-TO21
NMH06-00-XC-001-TO22
NMH06-00-XC-001-TO23

COURSE OBJECTIVES

COURSE / LESSON TERMINAL OBJECTIVE

Given the necessary tools, equipment and demonstrating safe cryogenic work practices, the HVAC Technician will create a freeze seal. Missing more than three steps will be considered as a failure of the lab practical examination.

LESSON TERMINAL OBJECTIVE

Reading the procedure 33MT-9ZZ02 and associate hand out material, the Heating, Ventilation and Air Conditioning (HVAC) Technician will develop skills and knowledge in understanding the problems that may occur while establishing a freeze seal. At the end of instruction, HVAC technician, using the laboratory freeze seal trainer will set up freeze seal equipment and establish a freeze seal.

LESSON ENABLING OBJECTIVES

EO01 PERFORM PRE-JOB FREEZE SEAL WALK DOWN

EO02 IMPLEMENT SAFETY REQUIREMENTS WORKING WITH LIQUID NITROGEN

EO03 DISCUSS FILLING DEWAR'S WITH LIQUID NITROGEN

EO04 INSTALL FREEZE SEAL CHAMBER

EO05 PERFORM A FREEZE SEAL

EO06 TERMINATION OF FREEZE SEAL

Introduction

Objectives / Sequence	Methods & Activities
I. Self Introduction	Introduce yourself and present your background and experience. Have the Students introduce themselves if desired.
II. Classroom Guidelines	Identify the CLASS GUIDELINES posted in the classroom. Discuss as necessary
A. Attendance Sheet	Pass the attendance sheet around and have it signed in black ink.
B. Materials	Ensure that the materials needed for the class are available for each student.
C. Questions and Participation	Discuss the importance of participation.
III. Attention Step	Get the attention of the students on you rather than outside interests.
IV. Course Introduction	Briefly introduce the course subject and how this course fits into the qualification program.
V. Motivation	Focus student attention on ”What’s In It For Me”.
VI. Course Pre-Summary	
A. General Schedule	Discuss the schedule for the course, i.e. amount of classroom, lab, break frequency, examination type and time
B. Course Terminal Objective (for first lesson of course only)	Read and/or discuss the course terminal objective. Identify tasks they will be qualified to do upon completion of the course
C. Questions and answers	Allow time for students to ask questions prior to beginning lesson.
VII. Lesson Introduction	Introduce the course material
A. Lesson Terminal/Enabling Objectives	Read and discuss the lesson objectives

Lesson

Objectives / Sequence	Methods & Activities
1. STAR SAFETY	
From start to finish, safety is everyone's concern	
1. Shop tail board meeting. to the Shift-Supervisors Contingency plan with all involved groups	S.T.A.R Everytime; all the time
2. Personnel safety	
3. Equipment: (plant safety)	Their safety and your safety insures job safety
4. Safety will be addressed through out this lesson and in the movies you will see.	A lost seal could be a topic of site safety, industry events and public safety. In the News Papers.
5. The individual that believes that gases wont hurt you can see that they easily can hurt you.	This is only an introduction, don't take the subject lightly.
	Wednesday June 18th, 50 S 45th Ave and Van Buren at Air Liquide. (Formally Liquid Air). **TP-0 and 00**
EO-01 Pre Freeze Seal Job Walk Down	
RISK ASSESSMENT:	
A. With each seal being different, a multitude of sequential questions can arise while planning a freeze seal.	
Is the work area open or is it confined? Do radiological conditions have to be addressed? What about height or overhead considerations. It a pit or trench area near by. Are toxic substances such as Hydrazine, Ammonia, Hydrogen considerations near by . In short, are you curious enough and willing enough to not jeopardize your own safety while performing your work?	If in a confined area, you must have taken the confined entry class. CBT
Risk assessment is everyone's responsibility, from management, to coordinators, planners and procurement individuals. Right down to and including you. With everyone doing their part in trying to foresee every possible danger, safety will not be left to anyone individual.	

Objectives / Sequence	Methods & Activities
B. 33MT-9ZZ02, PVNGS Nuclear Administrative and Technical Manual. Introduce **point 2.5 and 3.0, 4.0 and 5.0**	Read the first six pages of the procedure, up to **point 2.4.5.** These steps will be covered as we progress further on into the lesson.
C. Review evolution of job with use of plant drawings. Record on procedure, **PAGES 15, 16, 17** **NOTE PAGE NUMBERS FOR APPENDIX**	**TP-01, appendix B page 1** **TP-02 appendix C page 1** **TP-03 appendix C.page 2**
D. Verify pipe location, using appropriate drawings.	**Have shop tailboard meeting.**
E. Estimate supported work duration Procedure page 18 of 25	**TP-04 APPENDIX D, PAGE 1**
F. Remove insulation if necessary, minimum of six inches clearance on each end of the chamber. **Page 20 of procedure**	**TP-05**, **APPENDIX D, page 3 section 1. notify insulators** Security, Electricians, Safety, etc.
G. Follow the procedure, sign off steps as required	
H. Verify main storage tank levels in all three units. Know when tanks are to be refilled if the freeze seal will be an extended time. **Page 24 of procedure**	Get signatures on **APPENDIX F**, **page 1**, from Shift Supervisor Extended job, go to furthest tank
I. Fill enough dewar's. The standard dewar capacity is forty seven gallons.	On page **14** of the procedure is an estimate table for helping estimate the amount of liquid that may be required.

Objectives / Sequence	Methods & Activities
EO-02 Implement Safety Requirements Working with Liquid Nitrogen	
From this point, the material covered is closely similar to any work order that you may be given when working on a freeze seal.	Hand out training only work order.
A. Think through the job carefully, Freeze Seals are like Snow Flakes, no two are the same	There is no room for being unaware when planning the job
1. Use check lists, employ think tank team work. Cohesiveness is needed to cover all concerned areas	**Steps can be worked <u>Out of Order</u>** and not all items on the list may be needed
2. Team thinking can and will result in a superior job completion	
3. Handout of **condensed sequence** of the procedure can be useful	Assists the procedure, but is not the main guideline.
B. Injury prevention (skin, eyes, respiratory). Use all related safety equipment, cover arms, hands eyes, SCBA if warranted	Personnel Safety goes along with plant equipment safety
C. Oxygen Monitor use	Lowering /raising by rope is quick and safe. Leave in place if appropriate.
1. Use wherever, whenever necessary	
2. Have two monitors at least when in confined space area's and using nitrogen	Can displace oxygen gas quickly, one monitor can be checked against the other
3. Copus blowers; there can be more than one in use, with attached trunk lines to an open area. Route the lines overhead and out of the way.	
D. Use RWP Technicians for all radiation, smears, in the RCA along with ALARA	Radiological work practices with dose rate, as low as reasonably achievable

Objectives / Sequence	Methods & Activities
E. Establish boundary's and piping conditions	
1. Place caution tape, to alert people of potential hazard. Place oxygen monitor if work is close to the freeze seal	Yellow and black.tape.
2. Verify pipe is right pipe to be freeze sealed. Determine if pipe is stainless steel carbon steel or copper tubing.	A stiff shock or pounding on pipe with a hammer can break piping
3. Examine tubing for defects. Deep scratches, gouges, dents, flat sport, etc	Record in Appendix D page 3.
F. Prevent excessive force on piping	
1. Twisting	
2. Pounding	
3. Heating excessively, (especially when close to nitrogen chamber	Check on proper working pipe diameter distance from chamber to heated area, (two pipe diameter's)
4. If pipe is radioactive, check with Engineer's if extra support is required	Mechanical or Structural.
G. Avoid excessive internal hydraulics on component	30 pipe diameter's between the two freeze seals
1. Use procedures spacing to avoid or reduce internal pressure	
2. Excessive hydraulic pressure will rupture piping	
H. Monitor line pressure	
1. Have point where gauge reading may be possible to be taken	Observe reading periodically
2. If pressure appears to be excessive back off of completing the plug. Have engineers make determination	Pressures above normal working pressure conditions.

Objectives / Sequence	Methods & Activities
I. Contingency plan and lifting devices	
1. Decided upon and agreed to by different shops during the Shifter's tailboard meeting and then sign the appropriate appendix. **Procedure page 19 of 25**	**TP-06, Appendix D, page 2**
2. The plan :(two copie's) one for control room, other in the work order.	**CRDR 9-5-0158.** Seal can be installed but not used as a boundry until the briefing is held.
3. Contingency plan should be in writing on appendix and continuation sheet	The continuation sheet is considered optional, but most worker's will read the continuation sheet
4. All new worker's, during a shift change, should be aware of the plans steps	
5. Whenever the crane is used to raise or lower Dewar's, a spotter should also be available around the clock	Rigging qualified
6.Two people at the freeze seal site, two for filling and transporting dewars.	**CRDR 9-5-0158 B** Minimum number of people required.
EO-03 Discuss Filling Dewar's with nitrogen	
Personal Protective Equipment:	
Face shield, leather gloves apron, preferably a long sleeved shirt, etc. (when handling the equipment that comes contact with the liquid). There is dispute over the advisability of wearing gloves while handling liquid nitrogen because there is a belief that gloves could fill with liquid and therefore prolong hand contact which would make burns more severe. If gloves are worn, they should be loose fitting and easily removed.	**A.** Safety All safe working practices will be adhered too
Lab coat, overalls or apron are advisable to minimize skin contact. Also wear trousers, preferably without cuffs, over your shoe or boot tops to prevent shoes filling in the event of spillage.	1. Long sleeves 2. Faceshield 3. Appropriate gloves 4. Apron 5. Barrier/tape, caution 6. Dewar moving cart
NITROGEN:	
A colorless, odorless, tasteless inert gas element which makes up approximately 79% of our atmosphere. Boils at -195.8 Degrees Centigrade or -320.44 Degrees Fahrenheit.	Causes suffocation

Objectives / Sequence	Methods & Activities
B. Follow procedure, know how much Nitrogen can be taken from the Cryogenic storage tank as shown in the appendix	Each of the three units tank is checked and each Shift Supervisor makes a low limit cut off determination and signs the Appendix sheet
C. Nitrogen is -321 Degrees Fahrenheit or-273 Degrees Centigrade. It is an inert gas that when in the liquid state weighs approximately 6.73 pounds per gallon which expands rapidly, at atmospheric pressure. A dewar holds 47 6 gallons,Nominal so 47 X 6.73 =320.34 pounds, plus the weight of the dewar, 255 lbs, tare.or 575 lbs. If maximum fill is done, then 51.8 X 6.73 = 348.61, plus 255lbs tare weight for 603.6 lbs.	This is covered in more detail later in the lesson Guesstimate, using time, distance, degree of difficulty in transportation to job
1. When filling dewar's, establish a boundary by putting up caution tape so that no casual observer comes in harms way	Estimate the time to fill a dewar. From the freeze seal site to the storage tank. Consider a worst scene scenario. I.E, RCA?, Basement?, Roof?, What storage tank, etc. **Give yourself enough lead time.**
2. When the freeze seal chamber is installed on the pipe or pipes a caution boundary also needs to be established for the same reason as above.	
3. SCBA qualified personnel should be on hand when a freeze is created in a confined space	
4. Have one spare Dewar on hand, plus the one being used.	**CRDR 5-9-0158.** Min back up time of two hours.
D. Moving	
1. Use appropriate lifting device when lifting or transporting dewar's	Generally you want two or more carts. Take precaution of contamination if in the RCA
2. Dewar cart	
3.Truck with lift gate	Rope to tie off and secure dewar's
4. Crane	Shackles, caution tape, slings
E. Monitor Cryogenic Tanks	
1. Having obtained the shifters concurrence, and you expect the seal is to be of a long duration, fill dewar's from the 2nd or 3rd units initially	Know the days when the tanks are to be refilled. Know who to contact if all units cryotainers need refilling

Objectives / Sequence	Methods & Activities
F. Hook up transfer hoses, operate valves	
1. Install stainless steel transfer hose from tank to dewar, purge hose prior to opening dewar inlet valve. Tighten fitting to inlet valve threads.	Recommend that ends of hoses be kept sealed to prevent foreign material intrusion
2. Dewar has pressure buildup valve, which is closed. Open vent valve, relieve pressure. Open fill line valve into dewar. Open valve from tank	Liquid transfer begins
3. When full the dewar should show a solid stream of Nitrogen venting from the discharge valve. Close cryogenic tank valve, wait for flow and pressure to reduce. Close dewar inlet valve, then the outlet valve. Loosen transfer hose fitting on dewar, bleed off line and remove.	Fill estimated number of dewar's to be used, transfer to job site
G. If the job is in the RCA, run additional hose length from the cryogenic tank, up to and through the fence, attach a control valve to the end of the transfer hose. Establish a taped off area inside the RCA and post a sign.	Get the approval from RP prior to setting up hose. Normally only one dewar cart needs to be taken into the RCA.
EO-04 Install Freeze Seal Chamber	
A. Safety, be sure the pipe to be frozen is the correct pipe. Inspect pipe for defects, if problems are suspected an ISI test can be done before the chamber is installed	**TP-07, Freeze Chamber Show first movie**
1. A attention to detail needs to be followed when installing the chamber. Failure after installation could result in severe equipment damage and repercussions	Will see detailed example, sett-ing up an installing in the movie.
B. Follow procedure and when in doubt stop in the face of uncertainty and get help.	
C. If job is in radiological work are get RP concurrence	If seal may be for an extended period, record information in continuation

Objectives / Sequence	Methods & Activities
and follow ALARA where applicable	sheet. Write time / date / RP told
D. Using shop generated equipment list gather items to be used during the job	Most of the time this step is done earlier in the job and the chambers rope putty is put on using the comfort of the shop
1. All items on the list may not be necessary to obtain. Reviewing the W.O , the shop job briefing with fellow worker's can clarify what will be necessary.	Check list should be stored on the shop's computer
E. Select proper size diameter of Freeze Seal Chamber. Know inside diameter of chamber when both sides are placed together. Having measured the Pipe Diameter when walking the job down you can adjust the size of chamber to fit on the pipe by using PUTTY ROPE sealant	Clean chamber seals help insure sealant adhesives. Two or even three layers of sealant may be necessary to insure good chamber to pipe seal.
1. Carefully install the chamber around the pipe, using washers for additional compression. Tighten bolts snugly. Push extruded sealant into voids carefully to insure a tight seal.	Pushing putty up into the voids using a finger to make a concave arc will help prevent a nitrogen leak
2. Temperature probe sensing element cap to Teflon cylinder and cylinder to pipe must have a carefully installed putty sealant, compression ring so that no Nitrogen leaks through to the temperature sensing element or the temperature reading during plug creation will be erroneous, or called flooded chamber.	This ring should be rolled fairly thick and the ends that form a circle must be joined, so no nitrogen can find a way into the sensors area when the ring is compressed You want to measure pipe temperature, not the liquid nitrogen temperature.
3. Install the temperature probe and second putty compression ring and tighten the cap. Again the sealant should compress without the ring being broken.	On vertical pipe installation this ring might be more likely to leak. Creating a foam rubber ring and then a ring of putty placed inside the foam rubber can possibly insure a none leaking seal.

Objectives / Sequence	Methods & Activities
4. Insure the line to be frozen is full of liquid. Some pressure in line helps insure a better quality plug. Install nitrogen lines to the chamber. Tie off with rope if necessary to give additional support. **Page 20 of procedure.**	**TP-05, Record full line of liquid Appendix D, page 3, section 1.0.**
5. Verify pipe temperature. The higher the lines liquid temperature is, the higher the nitrogen consumption will be and the longer it will take to create a plug.	More than one chamber can be used, they can be placed back to back and be considered one seal.
AT what liquid temperature should a freeze seal not be started? 120 degrees F.	A second chamber can be placed with the proper distance between the two chamber's, which will reduce hydrostatic pressure build up. Refer to the procedure for proper distance.
6. In confined area or close quarter's, copus blowers may be used to blow gaseous nitrogen to a safe area.	Be sure to use an Oxygen Monitor to survey the atmospheric oxygen content
1. When a lot of equipment of requires an electrical source, take auxiliary power supply	Overloading of circuits can also knock out essential equipment
7. . Check work area boundary's and safety precautions and make any changes that is necessary. Establish boundary's and tape, rope off if feasible	
8. Insure that the installation is correct and auxiliary equipment is functional. Phones, temperature probes, radios, light's, blower's, impact tools.	Coordinate with other work groups that everything is ready and that any changes can be made before the seal is begun.
9. Check work area boundary's and safety precautions and make any changes that is necessary. Establish boundary's and tape, rope off if feasible.	

Objectives / Sequence	Methods & Activities
1. The work area must be environmentally safe as well as work safe, if not do not proceed until it is.	
10. Covering all events that can occur takes planning, that is why the other group's working need to be contacted, least you leave out an important step that may cause you concern later.	
1. If considerable time has passed, Review Freeze Seal briefing with associates, Cover who is to refill empty dewars and get them back and that all valves, controls, pumps, etc. are as they are supposed to be	Safety is to be remembered and considered at all times during the job. **IN FREEZE SEALS YOUR REPUTATION RIDES ON THIS ONE**, LOSE IT AND YOU HAVE LOST IT ALL
EO-05 PERFORM A FREEZE SEAL	
A. Depending on the job and its location a review of Safety concerns and the contingency plan with all groups should be considered	Whether an easy job or a hard one
B. Review procedure to insure all pertinent appendixes are initiated and signed and any last minute Safety Concerns are addressed	
C. Re-verify that the line is full of liquide specially if a long period of time has elapsed. **Page 20 of procedure. If a long time has passed**	**TP-05, Appendix D page 3.** Normally line is full of liquid when walking the job down, just be sure it is full prior to start of the freeze seal.
1. Determine if you can the amount of liquid flow in the line to insure that their is no void, air pocket in the isolated line. Excessive flow when attempting to create a freeze	

Objectives / Sequence	Methods & Activities
seal will prevent the seal from being formed.	
2. Can other valves, pumps be isolated if an excessive flow rate could prevent the completion of a freeze seal.	
D. Contact shift supervisor and obtain consent to begin the freeze seal	**TP-05, Appendix D, page 3 Section 2.0**.
E. Begin transfer of nitrogen to the chamber by opening the appropriate valves.	
	A few drops per minute is desirable
1. Record temperature of pipe on appendix, Start timing for log entry's onto appendix **Page 21 of procedure**	**TP-08 Appendix D page 4.** Initial temperature recording's are made **every five minutes**
2. Continually modulate the dewar valve to control the nitrogen flow out of the vent line	
3. This control of nitrogen is necessary to conserve the nitrogen usage and have the desired temperature in the seal chamber should the temperature probe, recorder become defective	
F. Using Time, Temperature and the Frost line out/away from both ends of the chamber states that a plug has been successfully made.	Technical judgment is also a factor, take your time, don't rush.
G. Contact Shift supervisor that freeze seal is made and request that an operator open appropriate valve or vent to verify that the seal has been established.	If in the RCA and the lines liquid is contaminated, drain to proper source. Have RP here to make certain that all safety steps in draining is adhered to.
1. Record in appendix D, page 3, section 2.0	**TP-09, show examples.**
2. If the temperature probe sensor becomes flooded, it is not necessary to continue making log entry's.	Make entry on **Appendix D, page 4,** you are stopping readings.
H. Record all information to the appendix and continuation sheet. Notify mechanical work group, welder's and anyone else that work can proceed on the	

Objectives / Sequence	Methods & Activities
valve or line to be repaired 1. Stay prepared, have contingency plan ready in case of plug failure	
I. Change out Dewar's and record how long each dewar was on line while maintaining the plug. 1. For job's continuing for indefinite period's Recommend you refill empty dewar's when you have two Dewar's left. Change out an MT dewar for a full one and you have one spare left to use.	Remember to allow time for transportation and crane operation if they are involved
J. Using temperature readings, frost line build up and time you believe the freeze seal is established. Contact operation to verify that a seal is indeed established. 1. Continue to take sensor reading after freeze seal is verified. A. Freeze plug seal is only a short distance to disaster.	Notify the Shift Supervisor and sign **Appendix D, page 3.** Once verified, readings can now be taken **every fifteen minutes.** **TP-10, Freeze Plug in Pipe.**
K. Document page 3 of section 2.0 that the seal is complete.	As you sign off the steps, continue to make entry's on the continuation sheet for tracking purposes.
EO-06 TERMINATION OF FREEZE SEAL	
A. Assure that each involved work group concurs that the necessary work is complete and the system / loop being worked on is closed	Record in continuation sheet
1. Termination of the Freeze Seal is obtained from the Shift Supervisor. **Page 22 of procedure.**	**TP-11 Appendix D, page 5.** Record Time, Name and Date
2. Discuss the method of thawing the Freeze Seal. Document that section 2 is complete.	Record on **Appendix D, page 5.**

Objectives / Sequence	Methods & Activities
3. Have Operations Operator verify that all valves, etc. are in the proper position.	Record in continuation sheet
4. Shut off flow of nitrogen to freeze seal chamber. Let remainder of nitrogen in chamber boil off.	
5. Remove nitrogen charging lines and remove freeze seal chamber.	
6. If using a heat gun to assist rapid thawing of the seal, start on liquid end of seal and slowly proceed to opposite end.	Temperature will rise rapidly, and frost will cover entire freeze plug area. Remove putty from pipe. Record thawing method on **TP-11, appendix D, page 5, section 3.0.**
B. Remove all Freeze Seal Equipment and return it to the shop	
1. Assure that the line is indeed marked with black felt pen.	This is to inform **ISI** where the inspection of the piping is to be.
2. Contact ISI, Engineering Evaluation's, that inspection of piping can be done.	Record on **appendix D, section 3.0.**
3. Notify insulation shop that insulation can be re-installed. Create W.O, put W.O # in package continuation sheet.	Record on **appendix D, section 3.0**
C. Review and fill in W.O continuation sheets, check and fill in app appendixes used. Close out W.O after ISI inspection is complete.	
BASIC SEQUENCE OF WORK TO PERFORM A FREEZE SEAL IN CONJUNCTION WITH 33MT-9ZZ02	THIS IS A CONDENSED VERSION AND IS NOT TO BE USED BY ITSELF IN PLACE OF THE PROCEDURE. **"TO BE USED AS A TOOL ONLY"**
Hand Out and Review	

Objectives / Sequence	Methods & Activities
	TP-12 through 15
DEWAR MAINTENANCE	
Dewar Description:	**TP-16 Precautions**
This cryogenic container is a vacuum insulated cylinder that is designed to furnish a liquid or gaseous oxygen, nitrogen, or argon on a reliable and economical basis.	**TP-17**
A internal pressure building system is provided with this container. It is sized to maintain pressure while gas withdrawal is taking place.	**TP-18** This system is automatically controlled by the pressure building regulator, but can be isolated by actuating the pressure building valve.
The insulation system is comprised of multiple layers of foil and paper that are incorporated with a very low vacuum. The **vacuum is factory sealed** and with the aid of internal molecular sieve it should remain low for the life of the container.	This insulation system coupled with low heat leak supports allows a small amount of heat into the inner vessel where it vaporizes liquid. If the container is left unused for a period of time the pressure will build to the safety relief valve setting. However, if the container is used in gas withdrawal service after pressure has built, the economizer system will automatically reduce the head pressure on the container without loss of product.
The inner vessel support systems, top and bottom are constructed of high strength stainless steel. This protects the unit from almost all vibrations and shock load.	
The foot ring has five rubber shock mounts designed into it. This absorb some of the handling loads and helps protect the container from damage. These shock mounts are installed in a position that places the rubber in compression and allows them to act like a cushion.	The inner pressure vessel is protected from over pressurization by a safety relief valve set at 235 psig and a rupture disc that is set at 400 psig. The outer container or vacuum space is protected by a reverse buckling

Objectives / Sequence	Methods & Activities
	rupture disc that is set at a maximum of 25 psig.
The cryotainer can be used for different gases. Make sure the tank is empty, purged and then a vacuum of 26 inches of mercury , repressurize the tank to 5 psig with nitrogen and repeat the 26 inches of vacuum.	**Keep transfer hose lines short as possible. Do not close the main supply valve and the dewar supply valve and walk off. The hose will rupture.**
Cryotainer Handling:	**TP-19**
Designed to withstand a two foot vertical drop or a tip over without damage. Clear the area, allow 15 minutes to insure no structural damage. Set upright and observe for 30 more minutes. If pressure does not build up and no observable structure damage is evident it may be put back into service.	If tank has oxygen in it and it is damaged, empty the tank, purge with nitrogen and repairs can be made.
Never store or transport a cryotainer on its side. When transferring liquid open the dewar vent valve, then the supply valve and then the main supply vessels valve. When full close the valves in the reverse order, remove the transfer hose.	**TARE:** the weight of a container, deducted from the total weight to determine the weight of the contents or load.
Liquid withdrawal:	
Transfer liquid into the container by opening the vent valve and then the liquid and transfer hose shut off valves. When the dewar is considered full, close the transfer hose shut off valve, then the liquid and vent valves. Loosen the fitting on the dewar to relieve the trapped liquid in the hose.	**Never leave the lines hooked up without purging when dewar is full**
	Settings
A cryotainer dedicated to liquid service will have different low pressure regulator and relief valve settings than a gas cryotainer..	Gas pressure building regulator, 125 psig Gas economizer regulator then set at 140.psig Replace gas reg with Liquid Pressure Regulator, set at 22 psig. Replace the 235 relief valve with on set at 22 psig.
Relief valve:	

Objectives / Sequence	Methods & Activities
The relief valve is designed to relieve pressure when it becomes excessive. If the relief valve operates at too low a pressure is should be replaced. If the relief valve does not operate within 10% of the pressure marked on it, then it should also be replaced. If the relief valve is operating at its set pressure but it operates too frequently, then the container should be examined. The container could be overfilled which causes a fast pressure rise.	
Threaded Connections.	
Threaded connections should be sealed only with an oxygen compatible sealant or Teflon tape. Swagelock Compression fittings can be reused if they are tightened properly. Thread sealant should not be necessary. The assembly should be put back together and the nut wrenched down until a sudden resistance to wrench force is evident. From this point wrench the nut 1/8 turn more so that the ferrule will spring into its seal.	**New Fittings, Swagelock** If new compression fittings are being used the nut should be screwed down finger tight and then wrenched 1 1/4 turn.
Rupture Discs	
The container has two rupture discs that protect it from over pressurization. The inner pressure vessel has a rupture disc set at 100 psig that will burst if the safety relief valve fails to operate. If this disc burst is should be replaced with one of the same size and pressure rating. NEVER substitute discs with different pressure ranges. The cause of rupture should be determined and corrected before the unit is returned to service. The annular space rupture disc protects the outer container from over pressurization. If it is ruptured this indicates that there is a leak in the pressure vessel or internal piping. This container should be returned for repair.	Do not touch or poke at rupture discs. They are constructed of very thin metal and can damage easily.. Failure to comply with this caution could cause damage to the container.
Pressure building and economizer regulator:	**TP-20**
If the container pressure builds higher than the normal set pressure of (125 psig) it is possible that the pressure building regulator failed to close properly. This can often be corrected by removing the piston assembly located on the	Valves: Spring loaded rotary stem which automatically compensates for thermal

Objectives / Sequence	Methods & Activities
bottom of the regulator and cleaning its seat. If this fails to correct the problem a regulator repair kit should be installed. Economizer regulator should be removed from the container before they are worked on Remove all pressure from the inner pressure vessel before any repairs are made to the container. An economical repair kit is available should cleaning fail to repair the regulator.	shrinkage and wear. Tank is empty, remove and clean seat of valve then reassemble. Liquid level gauge: Tank empty, remove and clean assembly. Replace any faulty parts. Clean assembly, reinstall float. The top indicator's white tip should be 3/8 inch below the empty mark. **MOVIE:**

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PLANT INDUSTRY EVENTS,	
01-GINNA, Freeze Seal Failure on Fire System	
This event took place at the Rochester Gas and Electric Ginna plant located in New York. 15 miles NE of Rochester	470 Mega Watt Plant. Went commercial in 1970. PWR, Westinghouse. Event took place 4/7/97. Docket No./LER 50-244
While maintenance personnel were removing sprinkler heads for system S-19/13 in a ship the freeze seal being used for fluid isolation boundary failed, resulting in a main control board alarm. Both the diesel and motor driven fire pumps starting and the occurrence of a localized deluge.	Cooling comes from Lake Ontario.
Due to dismantling of the pipefitter office the installed office sprinkler system was left with its downcomer piping and office ceiling sprinkler's intact and hanging unsupported approximately eight feet below the pipe shop ceiling sprinkler piping.	
In June 1996 a Work Order was initiated. The Work Order resided in the Planner's "to be planned" file until April 1997 when circumstances allowed manpower initiate the job.	
The individual assigned the work activity is also a Subject Matter Expert (SME) on freeze sealing. While evaluating the sprinkler removal task, he determined that using a freeze seal for fluid boundary isolation of the sprinkler piping could result in several efficiencies: 1. It would not be required to isolate and drain the Service Building fire piping. 2. It would not require compensatory fire watch activities. 3. It would not require Operation Personnel participation in holding, administrative actions and isolation activities. 4. It would provide an opportunity for freeze seal application practice and possibly OJT of other maintenance personnel.	
Upon consulting with the Planner and Fire System Engineer, the plans were confirmed.	
This portion of the fire system is classified as non-safety. Station administrative work controls allow the Planner to issue a Balance of Plant (BOP) work order **(no planning)** for this type of activity.	The word ASSUME was soon to be a

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It is expected that the work is of a nature that an experience and qualified individual can determine all necessary requirements and perform the task without approved procedures or approved work instructions to provide direction.	poor choice for everyone involved.
The ME proceeded to establish a freeze seal, unthread the unneeded downcomer from a tee, install a pipe plug and remove the freeze seal. After reaching freeze temperature for the prescribed time, a technician proceeded to loosen a sprinkler head to bleed off water downstream of the freeze seal and to verify the integrity of the seal. When reaching the last threads connecting the sprinkler head to the downcomer pipe, the sprinkler head blew off with a whoosing noise and then water gushed out.	**Lack of contingency planning caused a delay in locating the isolation valve.** The valve was chain locked open. Damages were minimal, due to floor drains.
CORRECTIVE ACTIONS: 1. Initiated a training work request to evaluate discussion of this occurrence in Mechanical Maintenance Toolbox training and Engineering Support personnel (ESP) training. 2. Revised A-1603.3, Work Order Planning, "Require Planner's to plan and provide an approved procedure or approved work instructions for BOP work activities such as freeze seals which might challenge plant operations. 3. Revised M-14 to move step to ensure that pipe is water solid and vented from the instruction section of the initial condition section.	
0 **2-OCONNE 1:** Plant was shut down for refueling and a freeze seal was being performed on the borated water storage tank. The freeze plug procedure did not provide adequate guidance for determining the amount of liquid nitrogen required. Two dewars of nitrogen was considered sufficient for the task. Freeze seal temperature monitoring to determine seal integrity was not performed.	South Carolina, 30 miles from W Greenville, PWR, 860 Mega Watt. Part of a 3 plant site. Owned by Duke Power, cooled by lake water. 10/7/87, LER 50-269
The 3 inch lines freeze seal was began at 21:30 hours, dewar was empty at 23:00 hours. Second dewar put on line, while first dewar was taken to be refilled. At 23:30 hours maintenance cut into the line to be repaired. 23:45, first dewar returned. Shortly thereafter,	Supervisor made this determination.

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the second dewar went empty and 1st dewar was put back into service. The refilled dewar which apparently had only bee partially refilled due to operator and maintenance personnel unfamiliarity with the refilling process lasted for only about 15 minutes. With the second dewar being refilled, the freeze seal failed and slightly radioactive, borated water leaked into the auxiliary building. Temporary use of gaskets and pipe clamps stopped the leak. Approximately 30.000 gallons drained out. Some water left the controlled area out onto the site grounds. The plant drain system has since been sealed off from the site. A permanent plant procedure that provides guidance training and controls has since been issued.	The release was within acceptable plant release limits. People unfamiliar with filling of dewars should have used a weight measuring device to help determine when the dewar was full.
03-RIVER BEND: Down for refueling outage. Two freeze seals were being used by maintenance personnel to allow repair of two isolation valves. Personnel; who had not been formally trained on these techniques, which provide isolation. One of the two Freeze Seals Failed, causing approximately 15,000 gallons of service water to flow into the auxiliary building. After the failure, due to the ongoing work and many other fluid systems in the auxiliary building and lack of auxiliary building lighting, operators were unsure of the leak location, extent of the leak, or the best method to isolate it. As a result, it took 12 minutes to secure the service water system. During this time water flowed into the auxiliary building and descended to lower elevations, causing: • Loss of Division II reactor protection system (RPS) power • Loss of non-essential electrical load center transformer, resulting in the following: **1.** Closure of residual heat removal (shutdown cooling) isolation valves for about 17 minutes resulting in a negligible amount of reactor coolant system heat up loss or normal lighting in the auxiliary and reactor buildings.	25 Miles N of Baton Rouge Louisiana. 940 Mega Watt B W R, GE Plant, Commercial operation in 1986 LER-458, 4/19/89.

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2. Loss of normal fuel pool cooling (backup fuel pool cooling capability was available).	
The failure of the freeze plug was attributed to procedural inadequacies and lack of proper training. Both freeze plug jackets were being supplied with liquid nitrogen from **ONE SOURCE,** which makes it difficult to ensure proper nitrogen flow to both plugs. The freeze plug failed, even though lines indicated that a plug had formed. The plant was not using temperature indication of the freeze plug jacket as a means of verifying adequate liquid nitrogen flow and freeze seal integrity.	Always use a temperature indicator, other means are used, but only experienced personnel should use them. When the seal is in an area of prime importance, the better the back up for true indication is, the better the chance of identifying a seal that is likely to fail.
CORRECTIVE ACTIONS:	
• Procedures have been revised to require an adequate supply of backup liquid nitrogen be available prior to commencing a freeze seal (Oconee)	
• A permanent plant procedure that provides guidance and controls for all freeze seal activities has been issued. (Oconee)	
• A weighing device has been made available to assist operators in determining whether a liquid nitrogen dewar is completely full (Oconee)	
• Each freeze seal will only be supplied by a single source of liquid nitrogen with backup supplies available, unless it is supplied from a bulk supply tank with a header. (River Bend)	
• Freeze plug installation and maintenance will not be performed by plant personnel until they have been trained on freeze seal installation and maintenance techniques and procedures. (River Bend)	
• Operations has issued a standing order which requires documentation of freeze plug information so that operators have it available when needed. (River Bend)	
• The operations department has issued a standing order which requires documentation of freeze plug information so that operators have it available when needed. This information includes location of Freeze seals, responsible supervisors, work order cross-references, start and completion dates, emergency telephone numbers, copies of appropriate system prints (P@ID's), contingency actions to be taken if the seal	

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fails and documentation of operator pre-shift briefing on the above information. (River Bend) • Freeze Seal jacket temperature will be monitored to ensure that liquid nitrogen flow is maintained. (For small diameter pipe freeze seals, this requirement may be waived.) (River Bend) • The design of electrical distribution load centers will be evaluated for drip proof integrity. (River Bend)	
04- Waterford-3 **Hinge pin repair and seal ring replacement for check valve in the high pressure safety injection system.** Plant in a refueling outage, associated cooling train was out of service and the reactor water level was above the elevation of the check valve. Two unsuccessful attempts were made over several days to establish freeze seal for isolation. Seal leaked on both attempts and work was postponed until after the reactor coolant level was lowered below the elevation of the check valve. The outage risk assessment task force understood that work on the check valve could, under some conditions, affect shutdown cooling, the package had **not been stamped as a "shutdown cooling concern,"** because the original schedule did not call for the work to be performed at reduced reactor coolant inventory conditions. When revising the work package to recognize the work would be done at a reduced water level without the use of a freeze seal, the potential for the work to affect shutdown cooling was overlooked. Following refueling, with the reactor vessel head reinstalled and the reactor vessel water level reduced to a level below the safety injection check valve, the check valve bonnet was removed to perform the repairs. The check valve is in a line that **interconnects with a loop seal in the pump suction** of the associated training of shutdown cooling. This train of shutdown cooling has now been placed in operation. When the valve bonnet was loosened and tilted to check for leakage, a substantial vacuum was noticed and the bonnet gasket was drawn into the valve body.	Taft Louisiana, PWR, Westinghouse 1165Mw plant. Cooled by the Mississippi River. Went commercial on 9-24-85 SER 3-91.

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The loop seal siphon was lost and air was drawn into the operating shutdown cooling pump suction. Control room operators noticed a sudden increase in reactor vessel water level due to the loop seal emptying back into the reactor coolant system. At the same time, both the shutdown cooling pump amperage and flow indications significantly decreased. The indications were steady, indicating that the pump was not cavitating but was air bound. The pump was secured and the opposite train was lined up to reestablish shutdown cooling flow approximately 19 minutes later. During this time, the reactor coolant system temperature increased approximately 10 degrees, to 100 F.	
Contributing factors:	
• The plant had established "reduced inventory level" administrative controls to prevent a loss of reactor coolant system inventory. Full implementation of these controls was not required when the refueling cavity was flooded and they were not considered when the work was rescheduled after the water level had been reduced.	Always check elevation of the seal versus the loop water system. A frost line will form even though the line has no water in it.
• The horizontal section of piping where the **freeze seals** were attempted was sloped such that it was about one inch higher than the vent path. Although the local **thermocouple and visible frost band indicated that a seal had been formed, the sloped piping created an air pocket at the freeze seal location that could not be properly vented,** contributing to the unsuccessful seal application.	
• The administrative procedure for work authorization preparation and implementation required that any changes in the scope or intent of a work package be designated as a major change and approved by the shift supervisor and the maintenance superintendent. The determination of whether changes in the scope were "major" was left to the judgment of the first line maintenance supervisor. The deletion of the freeze seal was incorrectly judged not to be a major change: consequently, the revised work package did not receive	As a front line individual, it is your responsibility to resolve questions that you believe are unclear.

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the required reviews and approvals.	
CORRECTIVE ACTIONS: • Administrative controls involving changes in work scope are being evaluated and revised to prevent recurrence of similar events. In particular, the deletion of the requirement to use a **FREEZE SEAL** will be defined as a major change in the work scope.	
05-CALVERT CLIFFS 1: During the 94 refueling outage a pressurizer surge line freeze seal was planned to facilitate planned pressurizer heater work. The **12 inch diameter pressurizer surge line** connects the pressurizer to the **42 inch diameter RCS hot leg pipe,** which connects to the reactor vessel. Installing a freeze plug in the surge line would allow draining the pressurizer while reactor defueling occurred. **A contractor was hired to provide freeze seal expertise.**	Maryland, 40 miles South of Annapolis, PWR, 845Mw, General Electric. Commercial operation 5-8-75. LER NO 317, 2/24/94 Discuss this column after the entire left column has been presented.
EVENT: With the RCS temperature at 105 degrees F and pressurizer temperature at 85 degrees F, refueling water level was raised to refueling level. At this level, 19 feet of water is in the pressurizer. For over 28 hours liquid nitrogen was supplied to a **33 inch long freeze chamber** mounted on the surge line. With frost bands evident around 150 degrees of the surge line adjacent to the bottom of the freeze chamber, the contractor and BGE decided a freeze plug was probably formed. This decision was based on the contractor's experience (i.e., freezing a 12 inch line typically happens over a much shorter period of time. **Frost bands are not totally reliable as the sole indicator for establishing a freeze seal.** The freeze chamber temperature had been stable at minus -309 for over 12 hours). However when pressurizer draining commended the freeze seal chamber temperature increased to minus -191 degrees F in about 10 minutes. The freeze plug was declared not formed. Pressurizer draining was immediately stopped. The freeze seal evolution and the pressurizer work were deferred to later in the outage.	What is the largest size diameter freeze seal that we are presently allowed to make at PVNG's 4 inch. We may with engineering's concurrence go up to six inches in diameter. An outside contractor will be called in for larger ones. What was the degree of the frost line around the pipe? Not good enough. -309 and not -321 or greater. A lot of loose and hot BTU's floating around. I wouldn't call this a loose of a seal

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	just because it leaked. The presence of mind allowed them to have a drain point to verify the seals creation, which didn't happen.
CORRECTIVE ACTION:	
In order to facilitate the FREEZE SEAL, the following parameters were changed:	
1. **The reactor was defueled.**	A lot of time and a lot of money, but an intelligent decision.
2. **RCS water level was lowered to just above the top of the surge line, but below the bottom of the pressurizer vessel.**	What does our procedure tell us is the upper limits of where a temperature may be to hot to create a freeze seal?
3. **RCS temperature was lowered to 70 degrees F.**	Ans.: 120 degrees at the initiation of the freezing operation. 33MT-9ZZ02, page 3, step 2.1.4
4. **Remote reading thermocouple were installed on the top and bottom of the surge line on both sides of the freeze chamber.**	Chamber is 19 inches longer than in the initial attempt. About 63% longer.
5. **A longer (52 in) liquid nitrogen freeze chamber was installed.**	Could a possibly larger chamber have or should have been used? Judgment call, but I would have like still a larger chamber.
	What is the rule on using two chambers together?
	Ans.: Butt together, separate dewars
The freeze seal was declared established in 40 hours of supplying liquid nitrogen to the freeze chamber. A substantial 360 degree frost band extending over 4 inches long on the pressurizer side of the freeze chamber and a 180 degree partial frost line of 1-2 inches on the reactor side were formed. Refueling and pressurizer work were performed simultaneously.	First band is great. Second band leaves a question mark in my mind.
COMMENTS:	Radiation, Conduction and Convection. What one was working here?
Thermal convection currents were set up between the freeze seal chamber and both the reactor vessel and the pressurizer such that 28 hours was not a sufficient time to form the freeze plug. Plants	Convection is the more likely.

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should be made aware that even though the pressurizer surge line is a **"dead leg"** of water, there is an internal temperature stratification in the line which set up a mess transfer of hotter water rising and cooler water falling inside the pipe. The internal current is adverse to the establishment of a freeze seal.	The conical or cone shape theory freeze seal is possibly what the plug was made up of and not the cylindrical shape like we are told it should be. Could you place four temperature probes, two at each end at 180 degree opposition at both ends, plus the probe location in the chamber?
Limerick:	LER 50-352, 9/29/90, 1055 MW, commercial on 2/1/86
While installing a freeze seal to support maintenance, an atmosphere Immediately Dangerous to life and Health (IDLH-Oxygen deficient) developed causing a serious safety concern and near miss accident. While attempting to apply a freeze seal to an overhead 20 inch line in a pipe tunnel, nitrogen diluted/displaced the oxygen content at the floor level. Based on a pre-job review with the freeze seal contractor management, a large fan was set up at the entrance to the pipe tunnel providing ventilation, however, the air flow turned out to be inadequate for the amount of nitrogen necessary to establish the freeze seal. After approximately 3 hours, two operators entered the area to perform non-associated blocking. They became lightheaded and immediately exited the area. A continuous air monitor at the freeze location read approximately 20% oxygen, however when tested, the floor level read less than 13%. Shift supervision was notified and evacuate the freeze seal mechanic from the area. The mechanic had been working in the vicinity of the pipe, above the ground level. The area was posted as a confined space until safe oxygen levels in the atmosphere were reestablished. After additional ventilation was installed and the atmosphere was verified safe, the freeze seal process was resumed.. Lessons learned included cold nitrogen is heavier than air, only room temperature nitrogen is lighter than air. Another lesson learned regards the oxygen monitors. The monitor, a GASTECH	

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GX 4000, must be in fresh air when turned on prior to being placed in a confined space. If the monitor is turned off, or power is lost during use, the monitor must be taken to fresh air prior to continuing use, or the reading will be erroneous The monitor calibrates itself to 21% Oxygen, PPM H2s and 0 PPM CO regardless of actual atmospheric content, and displays these calibration values although background levels may be above/below fresh air levels. **Corrective Actions:** The monitors have been tagged with a warning that the monitor must be placed in an area with fresh air prior to the unit being turned on. The Administrative Guideline procedure for implementing confined space/hazardous area permits has been revised to: 1. include additional information from the vendor manual for the monitor; 2. further delineate responsibilities of Job Supervisor, Industrial Safety Group, Qualified Atmospheric Monitoring Personnel, Shift Manager/Shift supervisor, and Medical Department personnel; 3. notify the Industrial Safety Group for a safety evaluation when a hazardous material or an inert gas (Nitrogen) is used within the power block, including any confined space/hazardous area. Notifications of the Administrative Guideline procedure revision were made to personnel via a memo distributed at the plant security access point.	

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Lesson

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I. Objectives Review	Review lesson terminal and enabling objectives to allow the participants to evaluate they have met them
A. Lesson Terminal Objective	
B. Lesson Enabling Objective	
II. Questions and Answers	Ask questions which implement the objectives to ensure the objectives are being met
III. Concluding Statement	Apply this lesson to the following lessons or in-plant future needs and/or address impending exams