National Welding Corp.

NASA and steel Liners

- New York Tunnel Siphon under NY Harbor
- TVA Blue Ridge Penstock, GA
- Silver Lake Tunnel LADWP, Burbank CA
- NASA Steel Reline Concept

Nash Williams
President

New York Harbor Tunnel Liner

- Narrows Channel is one of the most heavily used water transportation corridors in the World
- Two older New York DEP water mains prohibited dredging and needed to be relocated to a lower depth which required a new tunnel
- A Tunnel Boring Machine (TBM) began operations in 2012 boring out a 10 foot diameter tunnel 100 feet below sea level. The National Welding Corp (NWC) scope involved installing a 72” steel tunnel liner 9500 feet long from Staten Island to Brooklyn within this tunnel.
- Hurricane Sandy hit October 2012, flooded and destroyed the TBM which delayed NWC work 3 years and mandated accelerating installation which began and ended summer of 2015.

TBM Launch Shaft

Segmented Concrete Liner

Steel Liner Install

Threading pipe into launch shaft

Loading the Locomotive

30 Minute Drive to Brooklyn

Installing Steel Liner

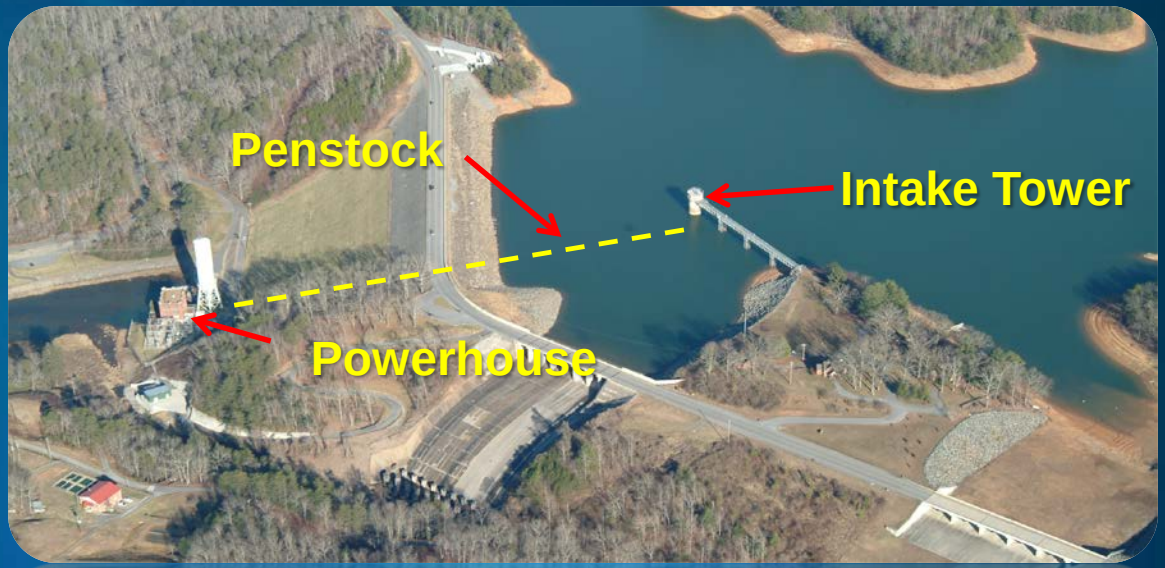
Adjusting to meet plans

New York Harbor Siphon

Production Welding

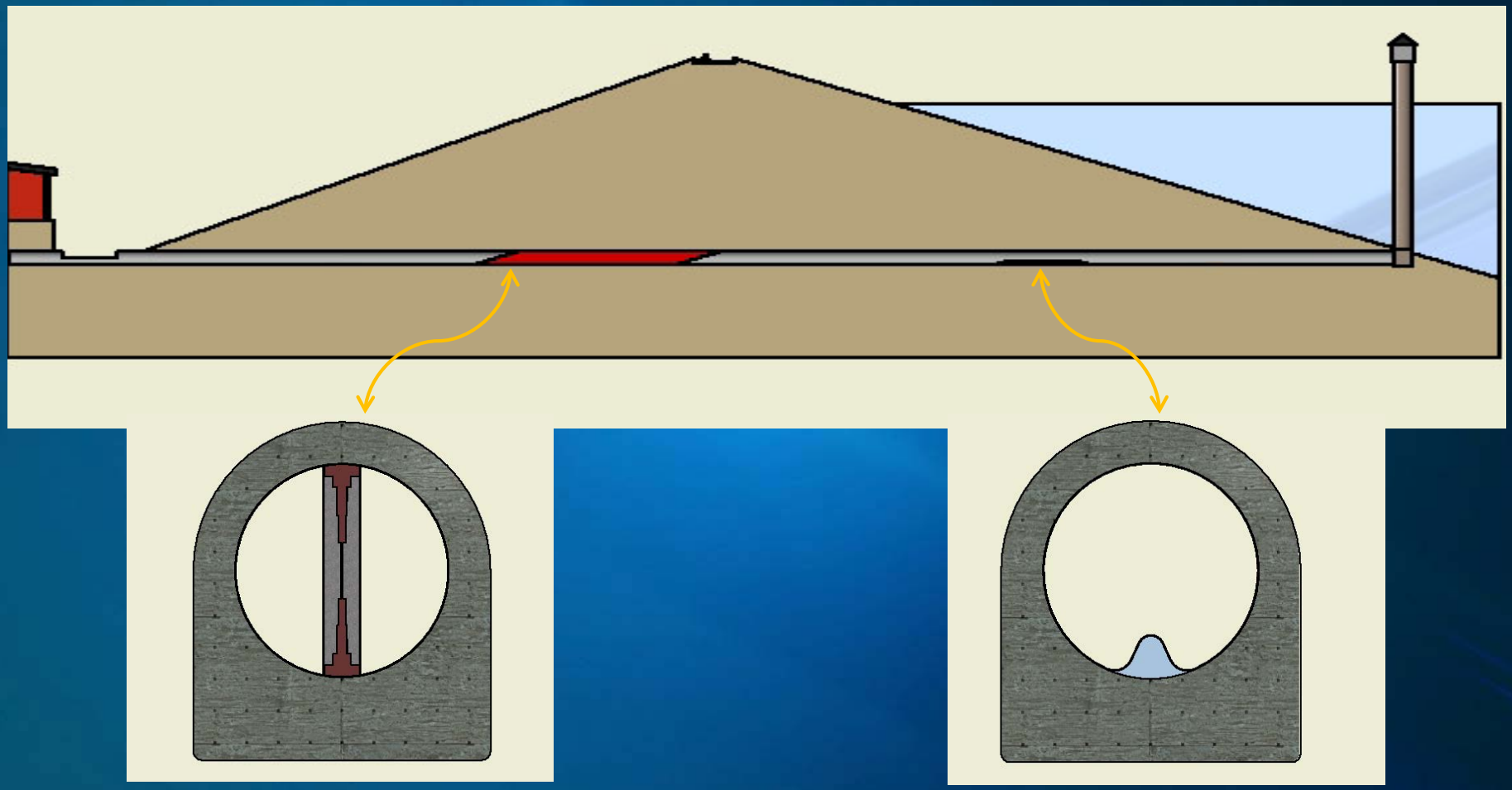
Blue Ridge Penstock Rehabilitation

Blue Ridge Dam Project



- Tennessee Valley Authority (TVA) is the owner of the 90 year old Blue Ridge Dam
- A 168” riveted steel penstock under this dam feeds a 25 MW hydroelectric plant at the dam base
- A section of the penstock began to deform from external loading and required structural reinforcement.
- Original remedy was to install a steel reinforced, concrete filled girder through the center of the penstock 160’ long by 18“ thick and weighing 300 tons
- TVA ultimate was to remove the girder and install a 147” x 1” thick steel liner then grout the annular void
- **National Welding Corp.** was hired remove the girder, develop the installation means and install the new penstock

Dam and Penstock Section View



Penstock Buckling 60’ Long x 36” Tall

PENSTOCK BUCKLING OCCURRED DUE TO EXTERNAL LOADING.

300 Ton Steel/Concrete Girder

GIRDER MEASURED 160 FEET LONG X 18” THICK AND 14’ TALL (FLOOR TO CEILING) STEEL AND CONCRETE MIX

300 Ton Girder Removed

THERMIC (OXYGEN) LANCE CUTTING TO REMOVE STEEL AND CONCRETE GIRDER

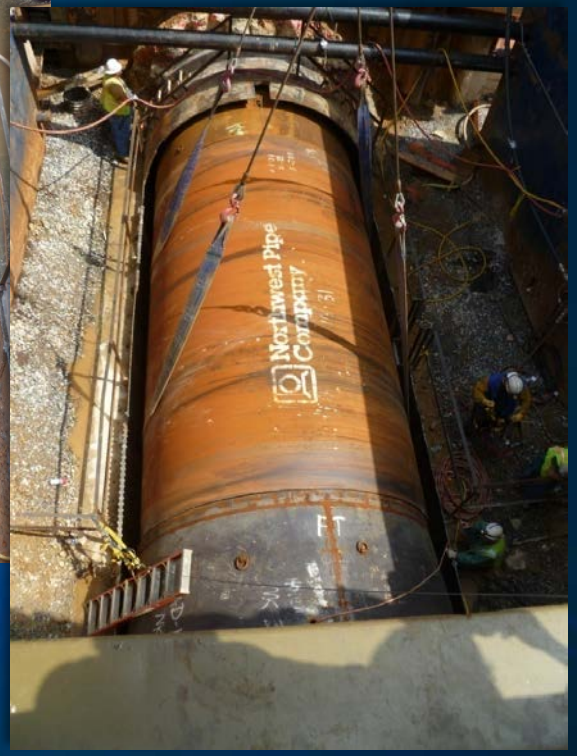
Reducer Assembly

168” TO 147” REDUCER INSTALLED IN QUARTER SECTIONS WEIGHING 4000 LBS EACH

Install Rail Sections & Carrier

RADIAL
MOUNTED RAIL
UNIQUE CARRIER

Penstock Installation



8” ANNULAR SPACE WITH 50,000 LB PIPE REQUIRED VERY ACCURATE TOLERANCES & GOOD CONTROLS

Final Section (tight fit!)

Silver Lake Steel Tunnel Liner

- 120” dia. segmented precast concrete tunnel casing with 96” x .563” x 3,200’ butt welded steel tunnel liner
- The steel liner providing a minimum 6” annular space which was later filled with 1000 PSI grout.
- After hydro testing both ends of the tunnel pipe were connected to the existing system by conventional cut and cover methods using bell and spigot welded steel pipe.

Tunnel Pipe Welding

- SMAW (Shielded Metal Arc Welding) or stick welding was specified for the project
- Pipe seams over 25 lbs. of weld metal and anticipated to delay the tunnel liner
- Alternate FCAW-G (Flux Cored Arc Welding with Gas) was proposed which is much faster, cleaner and has many superior properties to stick but was rejected.
- Mandated stick welding caused welding progress to lag several weeks behind installation
- Actual welding time for Stick was 2.5 to 3 times longer than Flux Core welding

Tunnel Liner Installation

- Project was performed during the hot season (August and September) with mandated around the clock installation
- The pipe was lowered by crane to the installation carrier at the tunnel shaft then transported to the installation location beginning at the far end of the tunnel

Liner Assembly

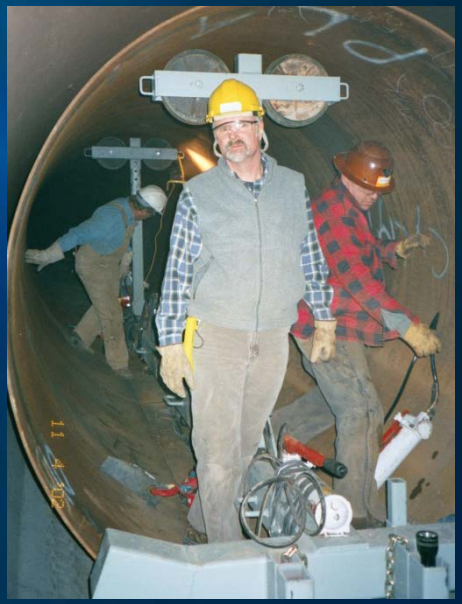
- The first pipe was positioned against and secured
- Additional pipe was placed onto the previously installed pipe utilizing a butt weld with steel backing
- Pipe was centered within the tunnel casing then tack welded to provide a temporary connection
- After adjusting to the final location the pipe was blocked to prevent further movement and secured for final fitting and welding operations

Ridges Basin Penstock

Bureau of Reclamation

Olmsted Split Steel Liner

Bureau of Reclamation UT



Specialized Equipment

NASA High Pressure Pipe Reline

Welded Joints

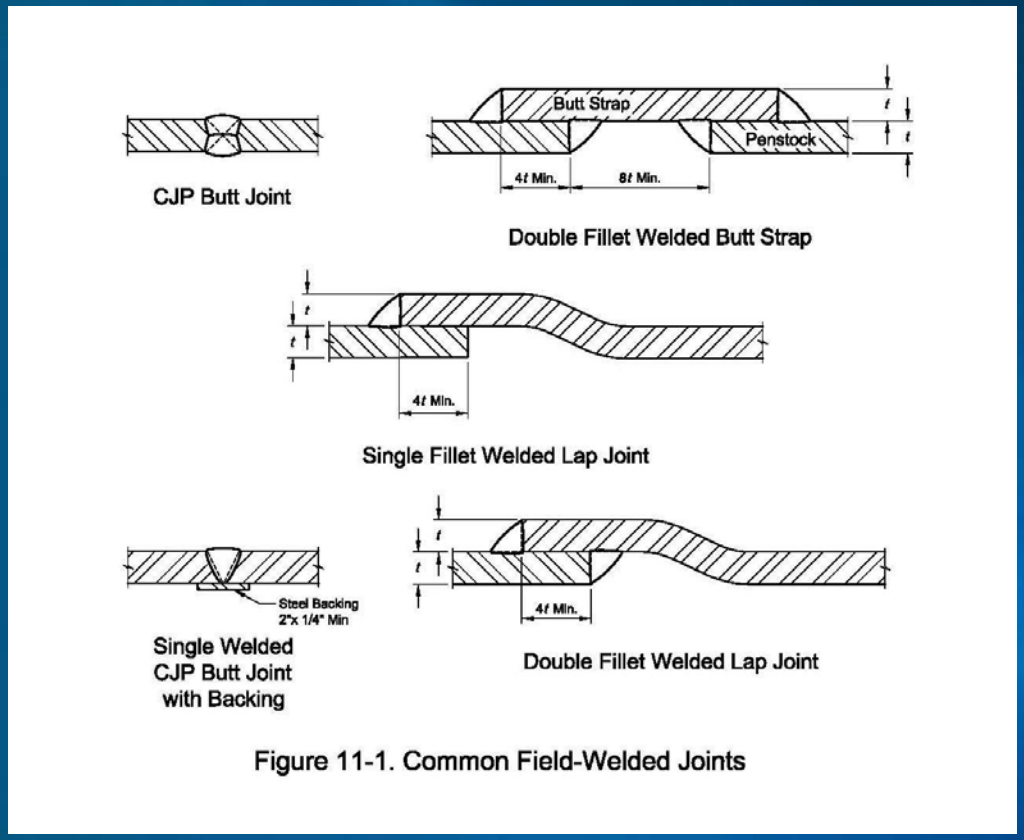
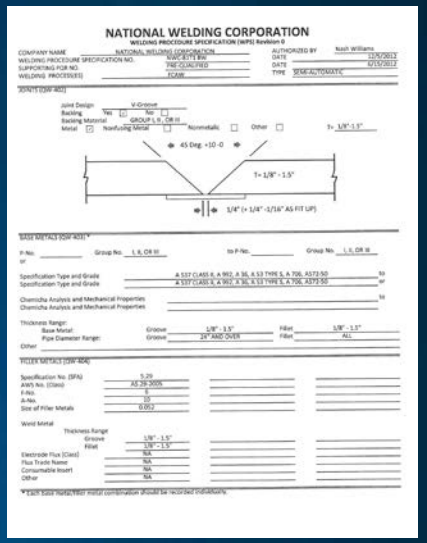
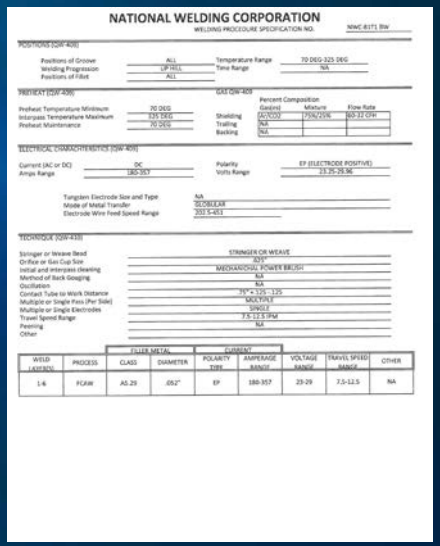
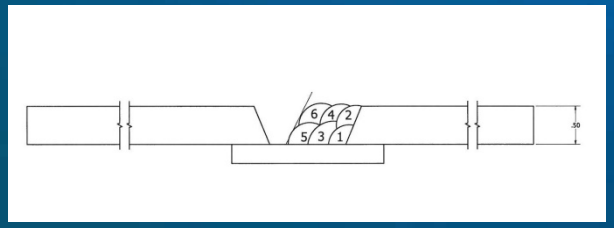


Figure 11-1. Common Field-Welded Joints

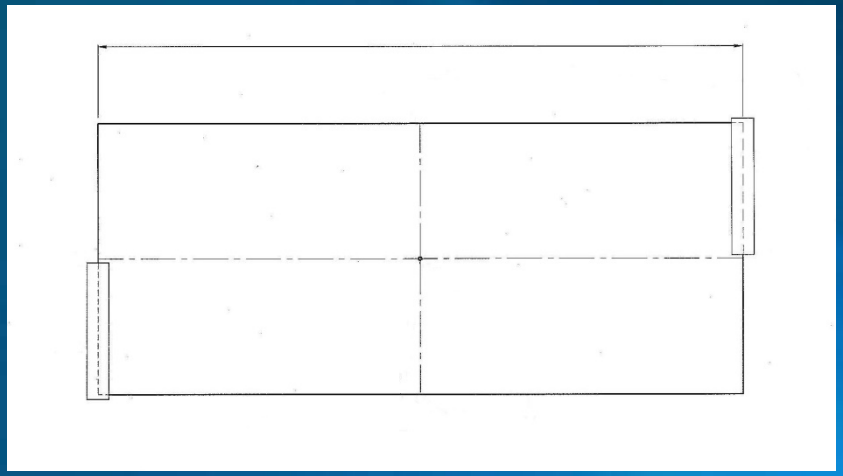




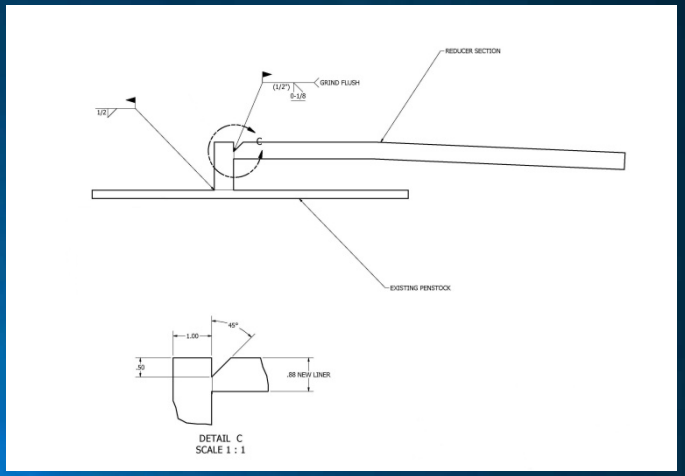


FCAW Welding

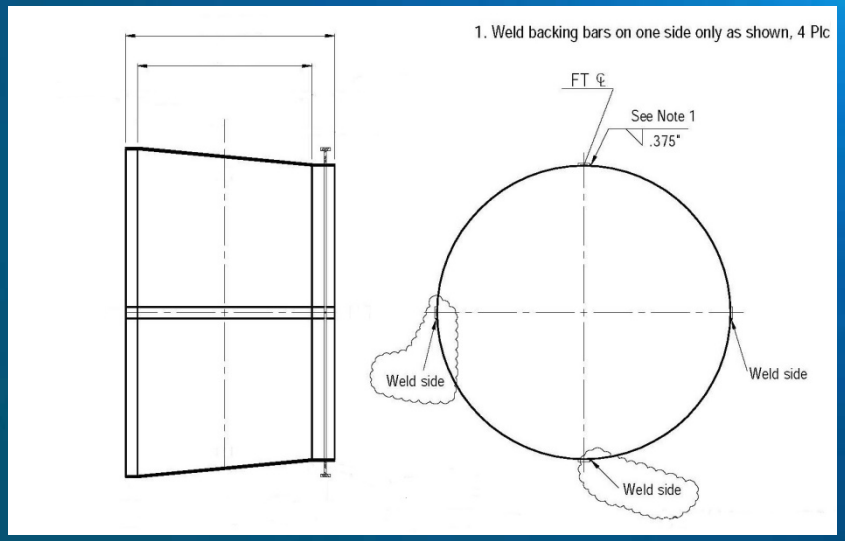
General Details



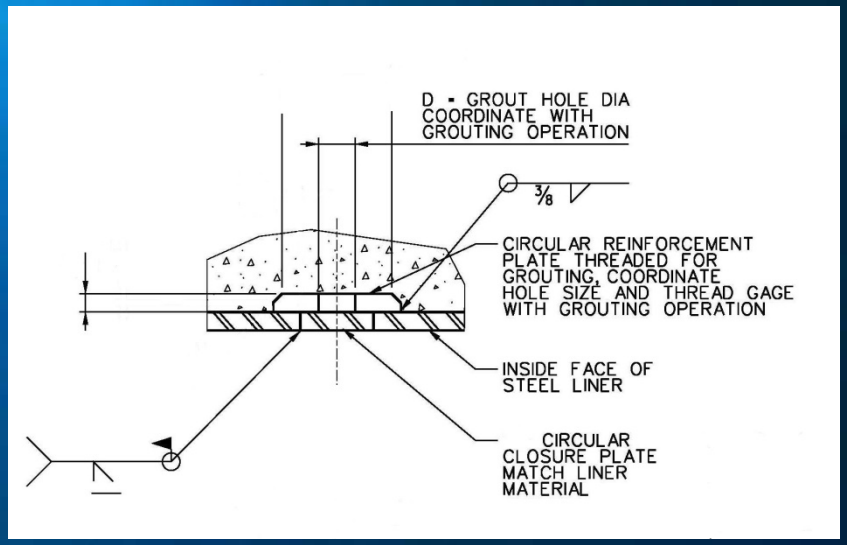
Pipe configuration



Termination Connection

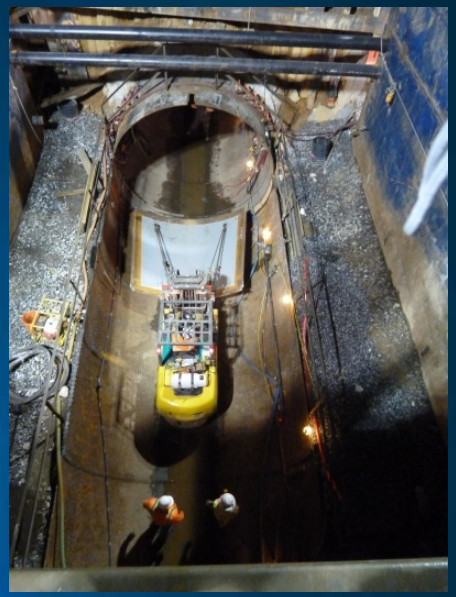


Reducer Connection

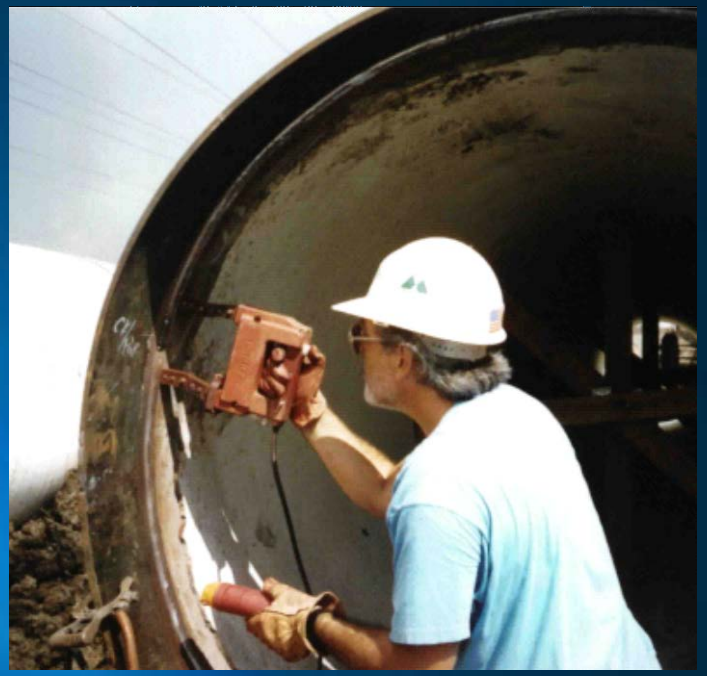


Grout Opening Connection

Reducer and Blocking Examples



Weld Inspection Methods



Ultrasonic Testing (UT)

- May be performed immediately after the joint has cooled from welding.
- May be performed with access to on side of the joint.
- Radiographic Testing (RT) cannot be performed without ID and OD access

Magnetic Particle (MT)

- Fillet weld inspection

NASA Project Preparations

1) **Sandblast and clean the host pipe**. This should be performed through the existing manways without breaching the current system. Cleaning will provide unencumbered access for inspection and running templet (s) through the host line.

2) **Verify the pipe geometry**. Our preliminary CAD sketches indicate that beginning from the A-Stand connection, the first installed 110' of new 64" pipe can be made in 30" long sections and the subsequent 500' can be made in 15’-20' long sections.

3) **Build a light weight templet** which can be broken down to fit through an existing manway then be reassembled within the host pipe to replicate the proposed pipe sizes. A duplicate templet could be added with a spacer bar to replicate the longer pipe lengths. Travel through the pipeline with the templet on a dolly to verify there is adequate clearance. Pay particular attention around the bends.

4) **Actual 64" OD pipe cut lengths** will be determined after running the templet. The final pipe lengths will be ordered and backing bars installed at the factory.

NASA Construction Sequence

1) Remove the top half of a 30' long pipe section from the 66" pipeline as a point of access and final tie-in location.

2) Place trench shoring to stabilize the section and prepare means for personnel access. The removed section should include approx. 12" new 66" pipe near the starting point which will be the new access/tie-in section. A reducer would be used for the tie-in.

3) A new 36" manway would be included in the tie-in section to provide continued access for the subsequent activities.

4)Install the first 110' of steel liner in 30" lengths beginning within A-Stand then install the subsequent 500' in 20' lengths until reaching the access/tie-in location.

5) The termination at A-Stand will be by using a transition with a sloped fillet to minimize turbulence. The termination at the access tie-in will be using a butt welded reducer.

6) **Laterals would be installed** subsequent to the steel liner and would be additive to this scope.

7) Butt welds inspected by 100% UT, fillet welds inspected by MT and any repairs would be performed followed by re-inspection using the same methods.

Post Pipe Installation Activities

1) Grout the annular space using a non-shrink grout mix. The grout will be pumped from within the pipe using 2" diameter ports.

2) High PH grout acts to passivate liner steel from external. Port plugs will be threaded into opening, seal welded and ground smooth after completion.

3) New 64" steel liner will be sandblasted to an SP-10 profile and recoated using field epoxy as was used on B-Stand

4) Manways will be placed using new gaskets and fasteners then secured.

5) Approximate durations based on current knowledge:

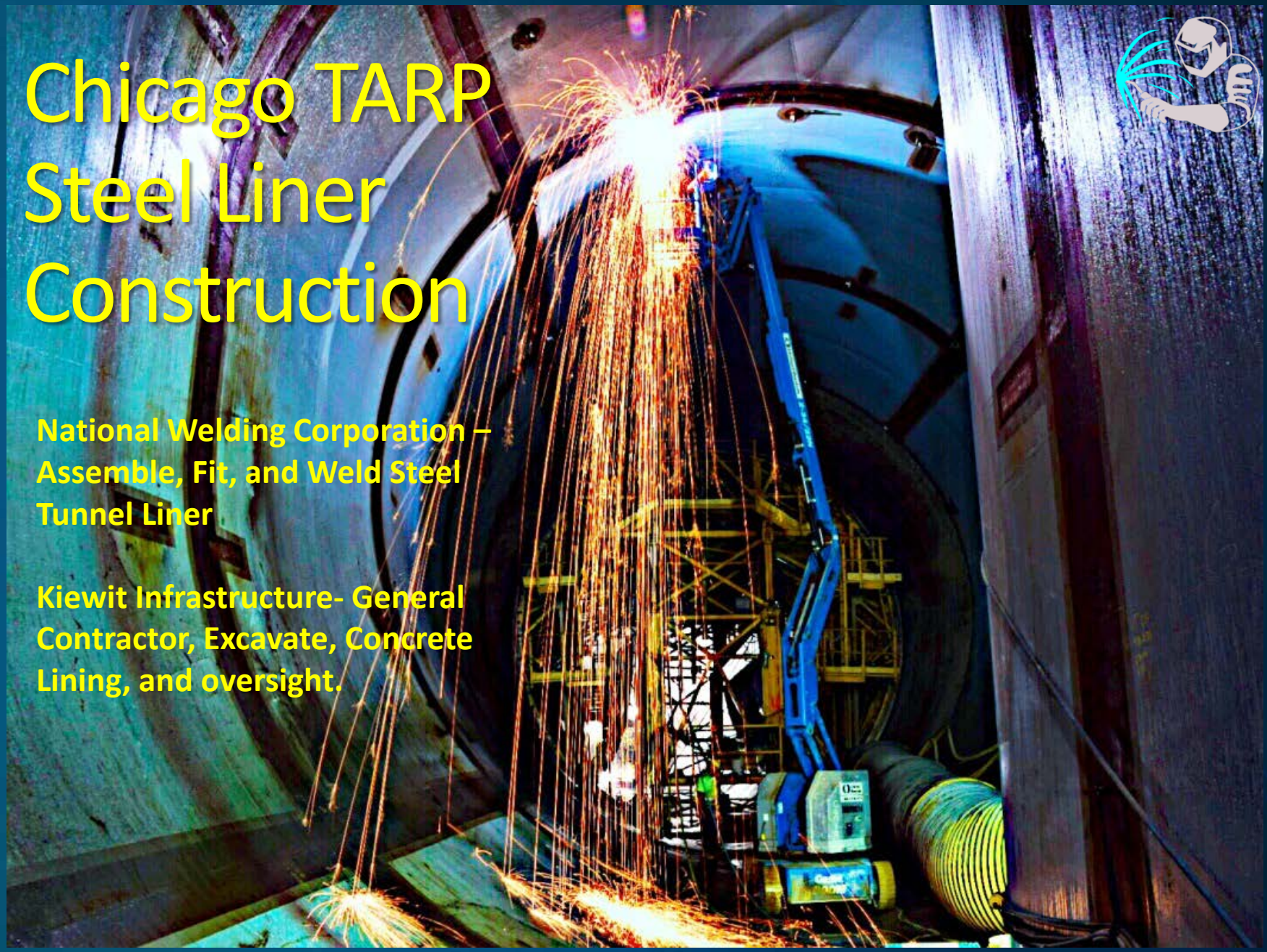
- Pipe Fabrication 3-4 months including submittals
- Sandblasting clean and templet 4 weeks
- Liner Install 10-12 weeks
- Grouting 2-3 weeks
- Final Sandblast and coating 4 weeks

In summary 19 weeks critical path.

Exclusions:

1) Final/actual design determined by others (NASA).
2) This liner concept anticipates using full pipe rings.
3) General support, backhoe, crane, trench box, dewatering etc. by others
4) Assumes oversight and support by Healtheon or NASA approved Contractor

Questions?



Chicago TARP Steel Liner Construction

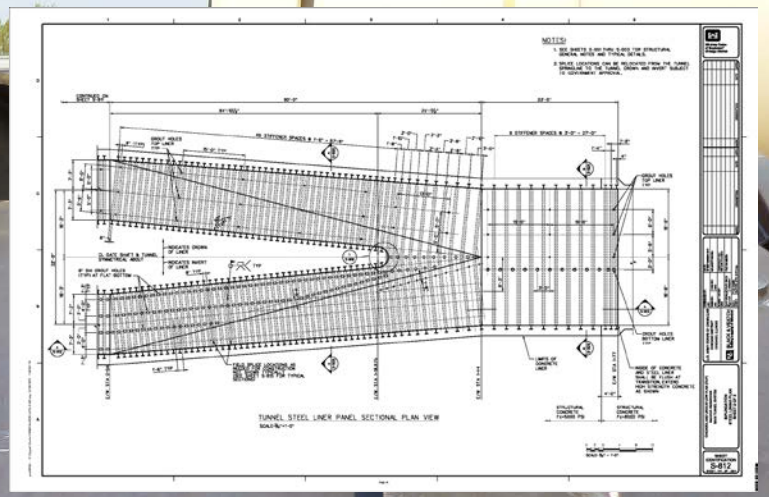
National Welding Corporation – Assemble, Fit, and Weld Steel Tunnel Liner

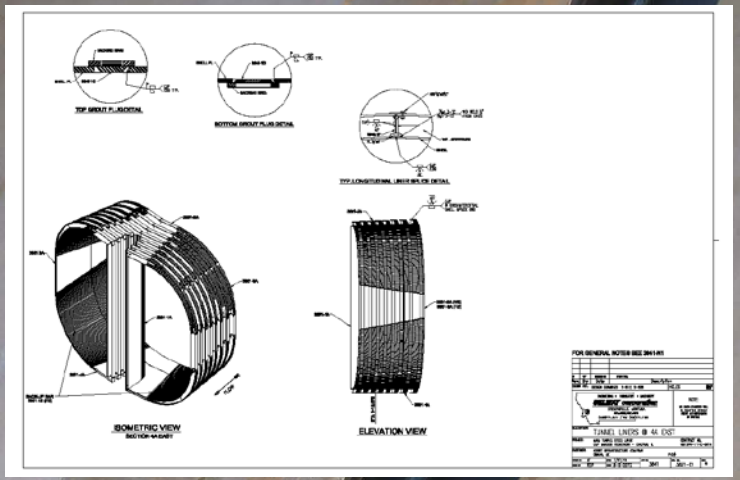
Kiewit Infrastructure- General Contractor, Excavate, Concrete Lining, and oversight.

Preassembly Planning

Design

- 354 ft of steel liner
- Bifurcation from (33 ft dia) to 19x32 ft rectangular section





- Changing Geometry
- “T” Steel rings

MCCOOK Mts BIFURCAITON

Surface Subassembly

33 ft. Diameter Pieces Assembled Onsite

MCCOOK Mts BIFURCAITON

Liner Support

Cross-Bracing Installation

MCCOOK M15 BIFURCATION

Final Fit-up and weld-out

- FCAW Welding
- Seam Fitting
- Roundness Tolerance

MCCOOK Mts BIFURCAITON

Handling 33 foot diameter sections

Rotation
of 180 tons

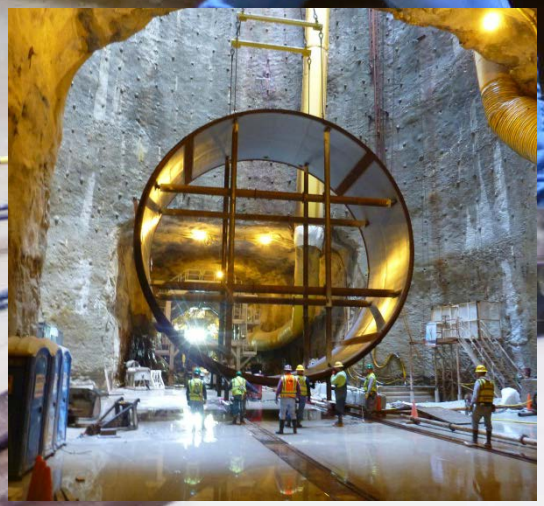
MCCOOK MLs BIFURCATION

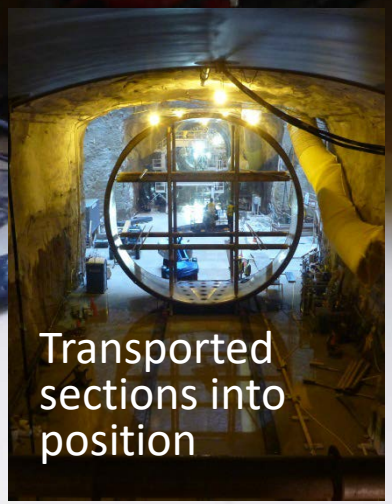
Handling 33 Foot Diameter Sections

Sections Lowered Down
300 ft Shaft

MCCOOK Mts BIFURCAITON

Tunnel installation





Transported sections into position

MCCOOK Mts BIHURCAITON

Finished Steel Tunnel Liner

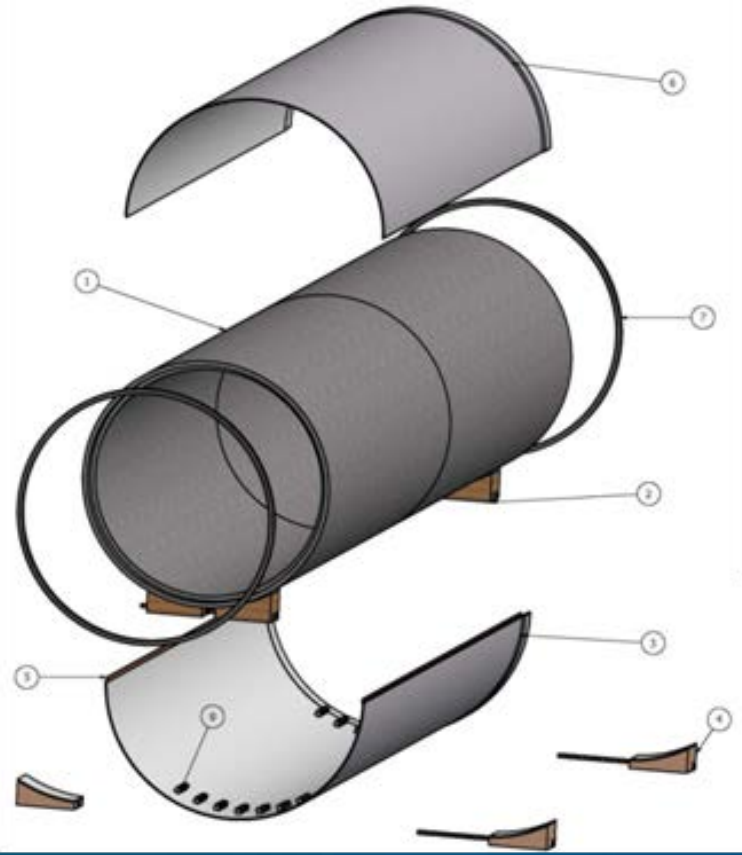
Key Elements of Success

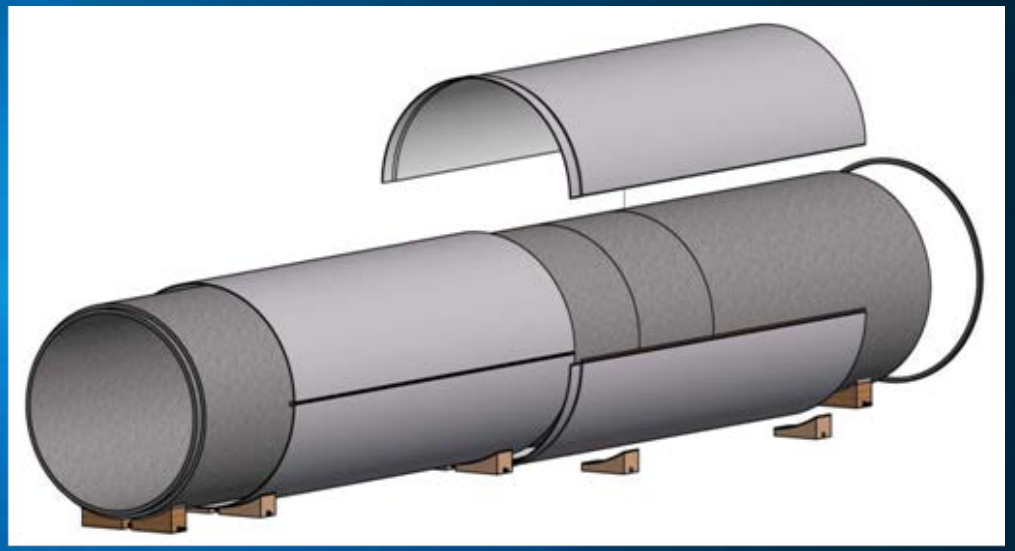
- Team Approach
- Experienced Team Members
- Careful Planning

SCR (Steel Cylinder Reinforcement)

For Pipeline Repair or Upgrades

Patented (SCR) Steel Cylinder Reinforcement system
to reinforce existing pipelines from the exterior





Steel Cylinder Reinforcement (SCR)		
Parts List		
ITEM	QTY	DESCRIPTION
1	1	EXISTING (HOST) PIPELINE
2	4	SUPPORT BLOCKS, HOST PIPELINE
3	1	SCR BOTTOM HALF
4	4	SUPPORT BLOCKS, SCR BOTTOM
5	2	LONG SEAM BACKING BAR
6	1	SCR TOP HALF
7	2	SCR SEAL RING
8	VARIES	ANNULAR SPACER BLOCKS

SCR Installation Sequence

Illustrated by a full scale demonstration

1) Clean host pipe, support and install shrink sleeves at seal locations

2) Install annular spacer blocks to provide minimal spacing then bottom half of pipe section

3) Install spacer blocks then top half of pipe section

SCR Installation (Ctnd)

4) Install SCR half pipe sections

5) Weld two longitudinal seams to create a flexible cylinder enclosure

6) Install temporary seals

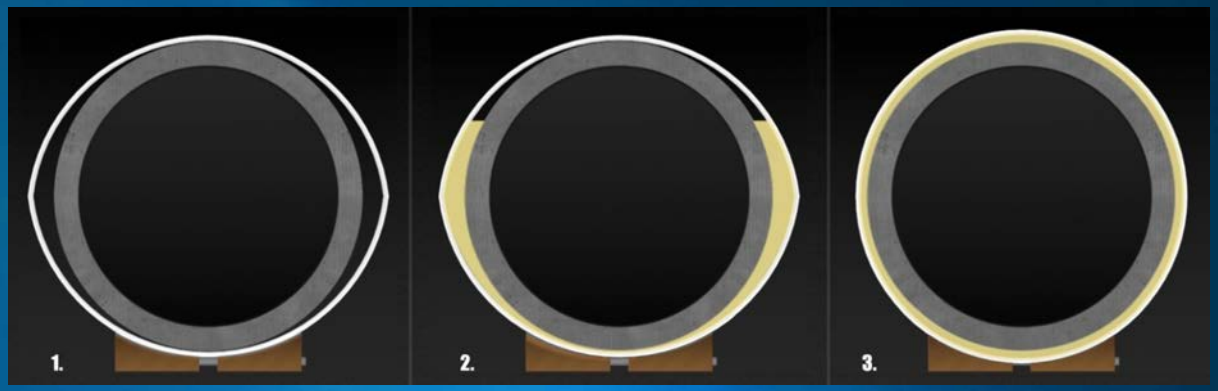
7) Insert seal retaining rings

SCR Installation (Cntd)

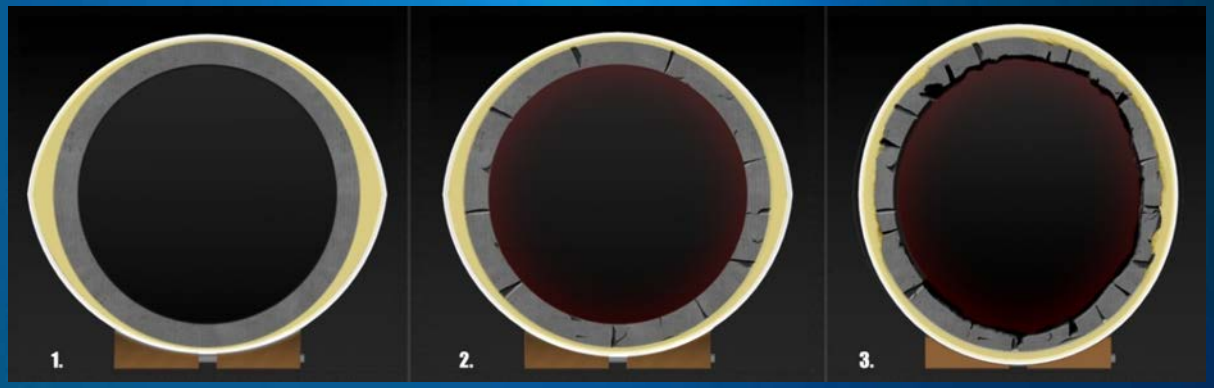
8) Fill annular space with nonshrink grout, vent air then pressurize until initial set. This will maintain rounding of the SCR cylinder.

9) Remove seals and install a subsequent SCR

Pressurized Grout and Seals



This exaggerated view demonstrates that our pressurized grout and seals round and maintain cylinder roundness.



Without pressurization the steel cylinder would ultimately be forced to round after the host pipe structure fails, which would cause nonsymmetrical loading to the cylinder.