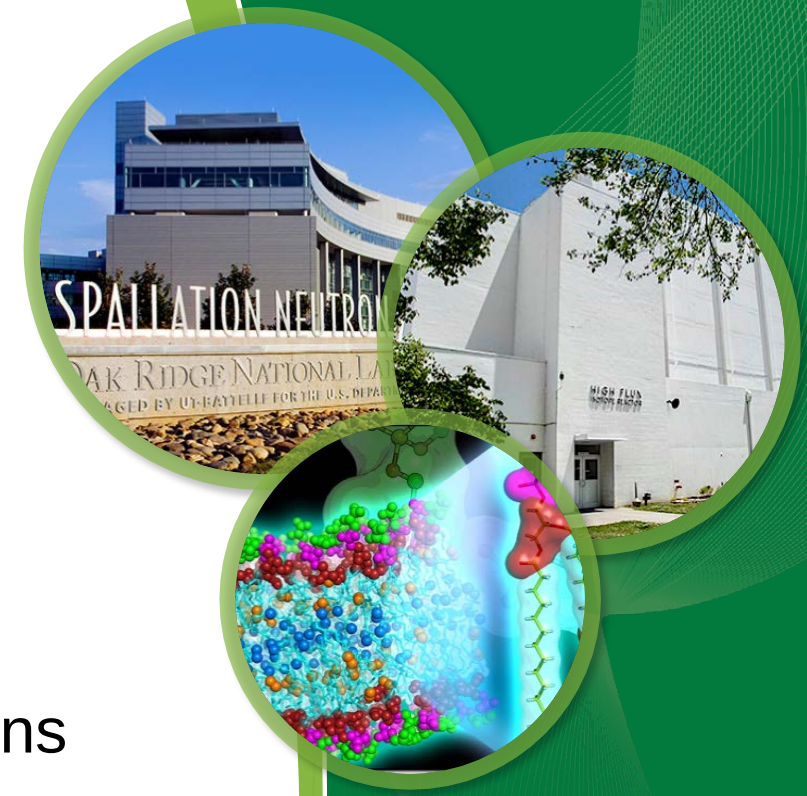
Horizon 2020 - 2nd BrightnESS Best Practice Workshop



SNS Target/Instrument Installations

Steve Proffitt

ORNL is managed by UT-Battelle
for the US Department of Energy

The SNS experiment hall (Target Building) was built to accommodate and support 25 instruments. Nineteen instruments have been completed and commissioned to date.

Begin with Safety

- Goodwill of civil and scientific communities
- Inclusive safety
- Craft ownership
- Safety program with incentives
- Safety culture inherited from facility construction
- Between construction and installation, more than 4 million direct work hours without a lost time accident

Organizational Support

- Instrument and Source Development Division
  - Division director, John Haines
  - Project Manager, Barbara Thibadeau
  - Instrument Scientist, for each instrument
  - Instrument Scientific Associate, for each instrument
  - Instrument Engineer, for each instrument

Support groups

- Survey and Alignment
- Safety Professional
- Beam Guide Vendors (installers)
- Choppers
- Detectors
- Vacuum
- Sample Environment
- Data Acquisition Systems
- Data Handling and Analysis
- Instrument Teams

Instrument Installation Group

- Group Lead, Steve Proffitt – Construction since 1966, experience in: mechanical, welding, rigging, supervision of union labor, B.S. mathematics, minor in management, labor & Industrial relations
- Installation Supervisor, Rob Connatser – Experience: Instrument installation, Scientific Associate, M.S. in physics
- Installation Supervisor, Mark Connell – Construction 10 years, experience in civil/ structural, surveying, M.S. in civil engineering
- Installation Supervisor, Rex Hogan – Construction (electrical) 15 years, project engineering 5 years, powerhouse maintenance supervisor 12 years, 5 year electrical apprenticeship

Instrument Installation Supervisors

Rob Connatser

Mark Connell

Rex Hogan

Mechanical Technicians

- Four mechanical technicians reported to Rob Connatser and performed technical assembly of technical components such as secondary shutters, revolver assemblies, etc.
- After several instruments were turned over for commissioning this group was moved to the Instrument Operations group and were borrowed as needed by the Installation Group.

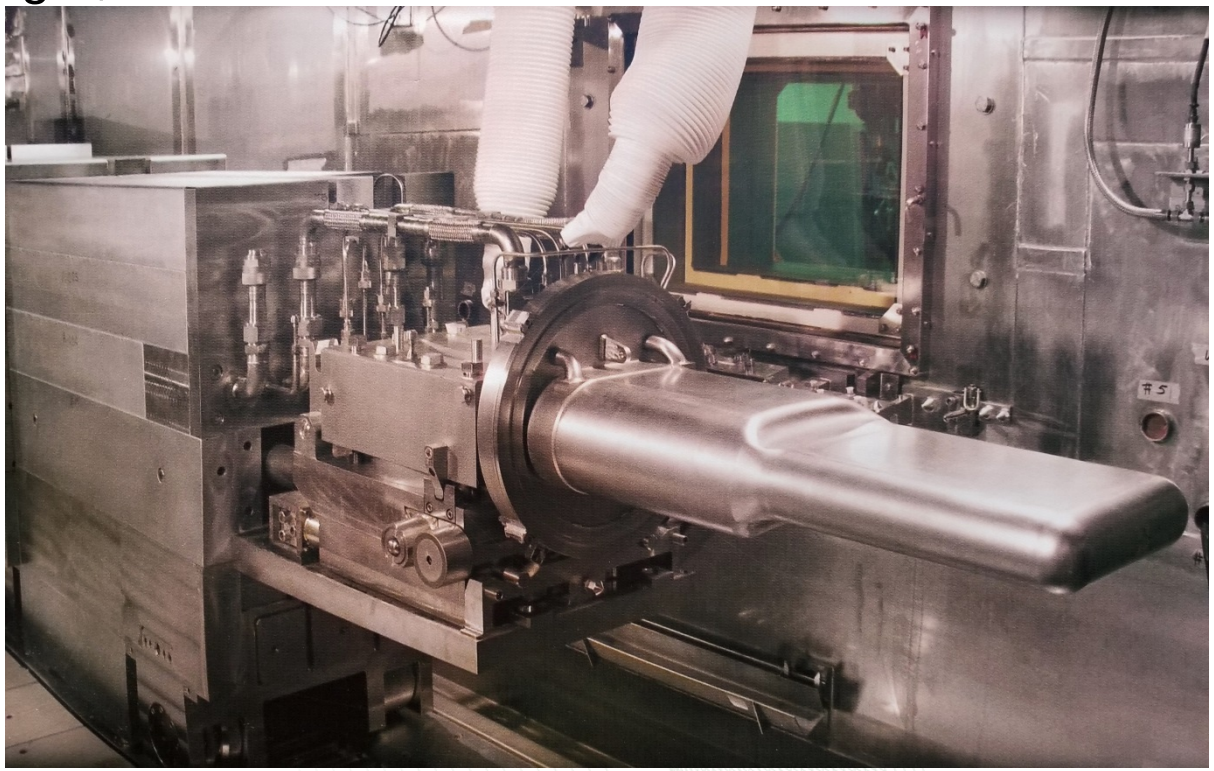
Technical Tool Installation Subcontractor Craft Labor

A Subcontractor was hired by the facility construction contractor to provide craft labor and supervision for installation of technical components and systems in the klystron gallery and accelerator tunnel in 2001 about four years before starting work on Instrument Installation.

The workforce came from the local building trades unions.

Target Installation

- The facility construction contractor installed the target cart, all of mercury handling components and piping, remote handling systems and all components inside the hot cell, except the target.
- The Target Group commissioned the remote handling systems, practiced and installed the first target,
- and, each target since.



Instrument Installation Environment

- Installation of instruments began in 2005 about a year and a half before completion of SNS construction, coordination was required with the facility contractor, but little with others.
- Design and planning were being pushed out in a rolling wave to keep ahead of installation.
- Procurements of Government Furnished Equipment (GFE) were progressing to stay ahead of installation with just-in-time deliveries due to limited storage space.
- Procurement strategies were still in-place from construction:
  - Subcontractor purchased all materials except GFE
  - With approved vendors, no submittals were required
  - Negotiated prices on commodities
  - Negotiated prices on regular and high density concrete


DeSHAZO
CRANE COMPANY
30 TON
2007/03/06

Instrument Installation Environment (cont'd)

- Instrument teams (Scientist, SA & Engineer) were in place and started installation early in 2005 providing supervision and oversight to the subcontractor.
- A team was formed later in the year with Rob Connatser as Installation Coordinator, four technicians, the scientific associate for each instrument, the Technical Tool Install subcontractor, and the craft labor.
- Work was assigned to the subcontractor using a Service Work Order (SRO). The SRO was a directive document that provided a charge number, direction, and attached drawings. The SRO authorized the installation and spending.

Instrument Installation Environment (cont'd)

- The Tool Install subcontractor and the craft had about four years installation experience in the klystron gallery and accelerator tunnel. Most also had years of construction experience.
- The Tool Install subcontract was a Time-and-Material (T&M) contract.
- The subcontract was later passed from the constructor to SNS.
  - The Department of Energy did not like performing construction using T&M.
  - T&M sometimes has a bad reputation for costing more.
  - T&M works well when customer realizes that they must control the risk.

Team Development

- Instrument installation began in March 2005.
- Fourteen instruments had been started, seven with limited front end concrete, seven with a quantity of shielding and cave construction completed, when I came onboard as Instrument Installation Group Leader in November 2006.
- I had worked with the group for several months on contract.
- The work looked to me to be more construction than installation.
  - Building concrete cave walls and shield blocks
  - Electrical utilities
  - Piping and mechanical utilities
  - These normal construction activities appeared to me to above 90% of the field work

Changes

- I saw the method of having the Scientific Associates (SA's) directing the subcontractor's work as an opportunity for improvement for the long term. Over a period of a year, I released them from their responsibilities for working the subcontractor.
- They were replaced with the team described earlier:
  - Rob Connatser, MS Physics
  - Mark Connell, MS Civil Engineering
  - Rex Hogan, Electrical
  - Adding my experience, the team had many years of construction experience covering mechanical, civil/structural, electrical, instrument installation, and physics.
    - Knowledge of OSHA requirements and safety procedures
    - Construction equipment
    - Construction practices
    - Craft union agreements
    - Depth of union craft skills
    - How to interact with craft
  - Additionally, we did not loose one every time an instrument was commissioned

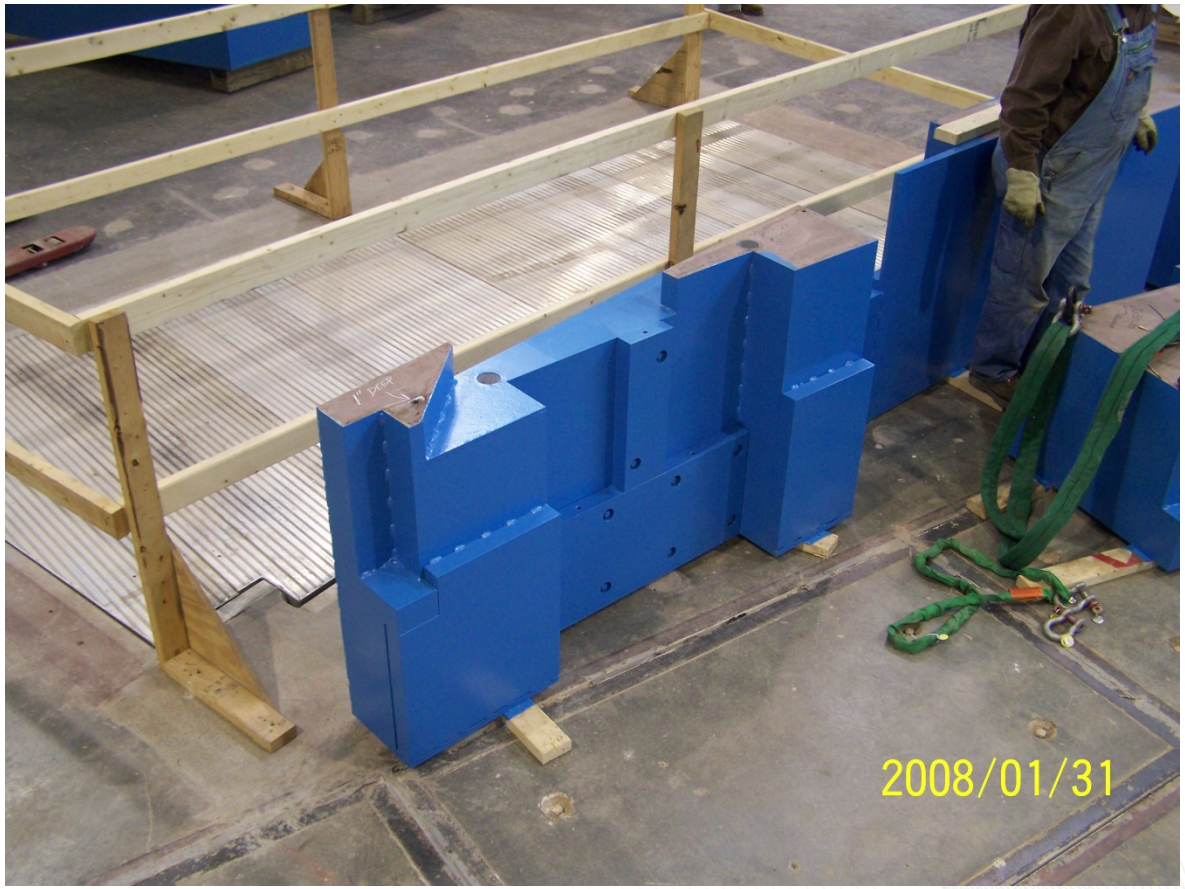
Evolution of shielding construction

- For the first few instrument beam lines some shield blocks were purchased and some were fabricated on-site.
- Purchased blocks were a mixed bag. Some were very good, some not. One of the purchased blocks was found to not have the specified rebar in it.
- On-site fabricated blocks were formed with commercial lumber, plywood, and standard forming hardware. Rebar was fabricated by the supplier and was assembled and tied by our Ironworkers.
  - Precision was just OK, but not great.
  - When HD concrete was placed, some sides would bulge and allow the block to belly out.
  - We were trying to maintain a ½" gap between the blocks.
  - The Carpenters were placing the studs on 16" centers as if framing a house. We insisted they put them on 12" centers for high density concrete making a substantial improvement.
  - Our radiation scientist allowed the engineers to design to a ¾" gap. This solved the problem.

Evolution of shielding construction

- The next step was using engineer purchased steel cans
  - Steel cans were fabricated by local fabrication shops and flame spray coated on the outside with ZnAL.
  - Steel cans eliminated the need for forming (and carpenters).
  - Steel cans eliminated the need for rebar (Some was used).
  - Each set was test-fit in place before the concrete was placed.
  - Accuracy was much improved.
  - ½” plate made sturdy cans.
  - Thinner plate did not work well.

Steel cans worked much better for multifaceted blocks.

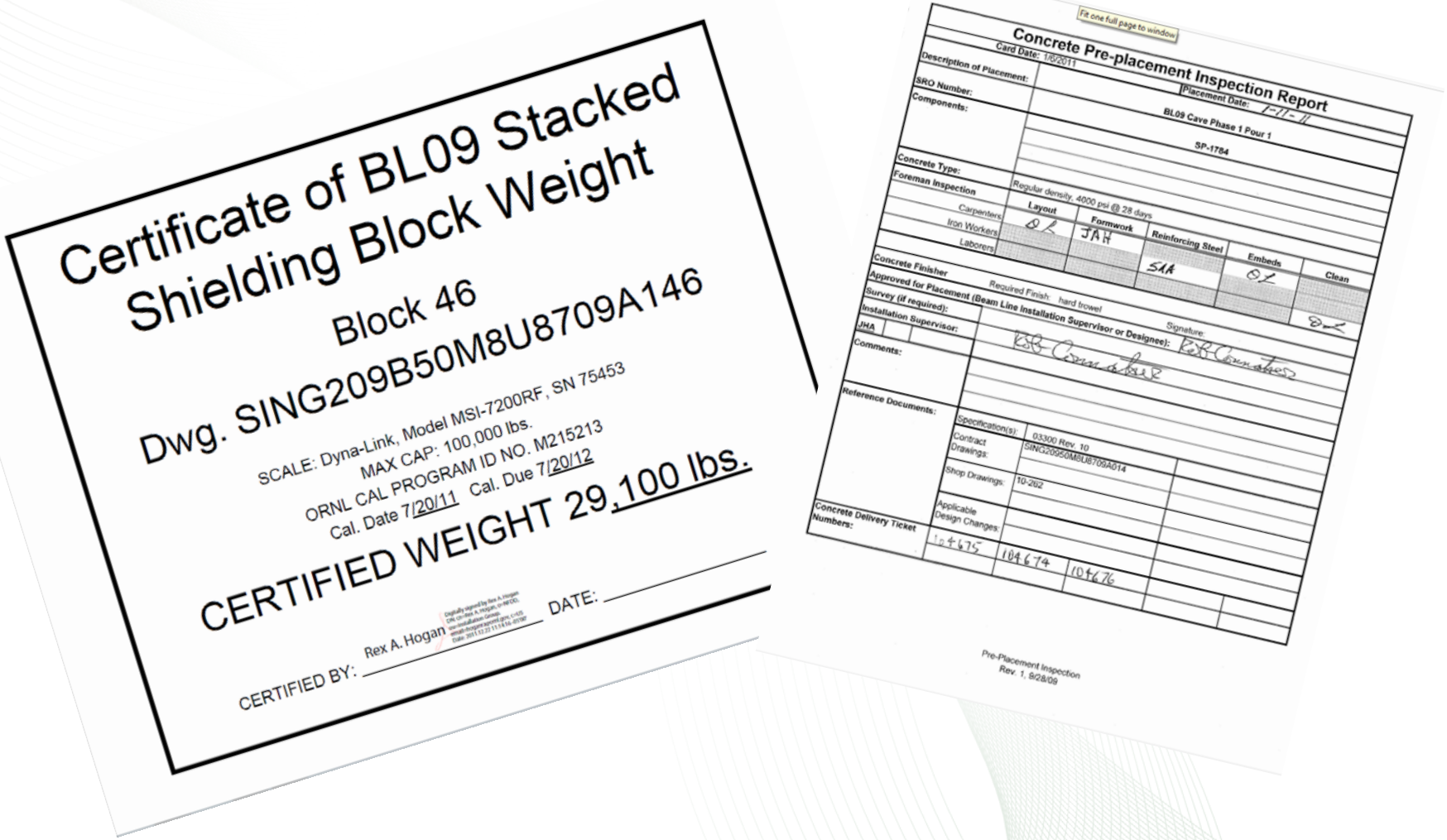


Modifying a block

Shielding block and wall quality

- Inspections with sign-offs were performed prior to concrete order.
- Delivered concrete was independently tested before placement and mix tickets were collected.
- Sample cylinders were collected and compression tested at 7 days, 28 days, and at 56 days if specified strength was not reached by the 28th day.
- Blocks were weighed using calibrated load cells and weights were certified by the fabricator, or by the Installation Supervisor if made on-site.
- Rebar certs were provided by the supplier and filed.
- Quality documents were provided to the engineer.

Quality documents



Certificate of BL09 Stacked Shielding Block Weight

Block 46

Dwg. SING209B50M8U8709A146

SCALE: Dyna-Link, Model MSI-7200RF, SN 75453
MAX CAP: 100,000 lbs.
ORNL CAL PROGRAM ID NO. M215213
Cal. Date 7/20/11 Cal. Due 7/20/12

CERTIFIED WEIGHT 29,100 lbs.

CERTIFIED BY: Rex A. Hogan DATE:

Concrete Pre-placement Inspection Report

Card Date: 1/6/2011

Description of Placement: BL09 Cave Phase 1 Pour 1
SRO Number: SP-1784
Placement Date: 1-11-11
Components:
Concrete Type: Regular density, 4000 psi @ 28 days
Foreman Inspection

	Layout	Formwork	Reinforcing Steel	Embeds	Clean
Carpenters	DL	JAH	SHA	DL	DL
Iron Workers					
Laborers					

Concrete Finisher Required Finish: hard trowel
Approved for Placement (Beam Line Installation Supervisor or Designee): Signature
Survey (if required):
Installation Supervisor:
JHA
Comments:
Reference Documents:
Specification(s): 03300 Rev. 10
Contract Drawings: SING209S0M8U8709A014
Shop Drawings: 10-262
Applicable Design Changes:
Concrete Delivery Ticket Numbers: 104675 104674 104676

Pre-Placement Inspection
Rev. 1, 9/28/09

Temporary Shielding

Temporary shielding was used to shield workers and for background reduction as dummy shutters were replaced with real shutters.

During outages temporary shielding was removed to facilitate design and to facilitate chopper cavity and upstream construction.


2014/02/05


2008/04/23

Temporary Shielding

- It also makes a good counterweight when the crane hook boundary has not been accounted for.

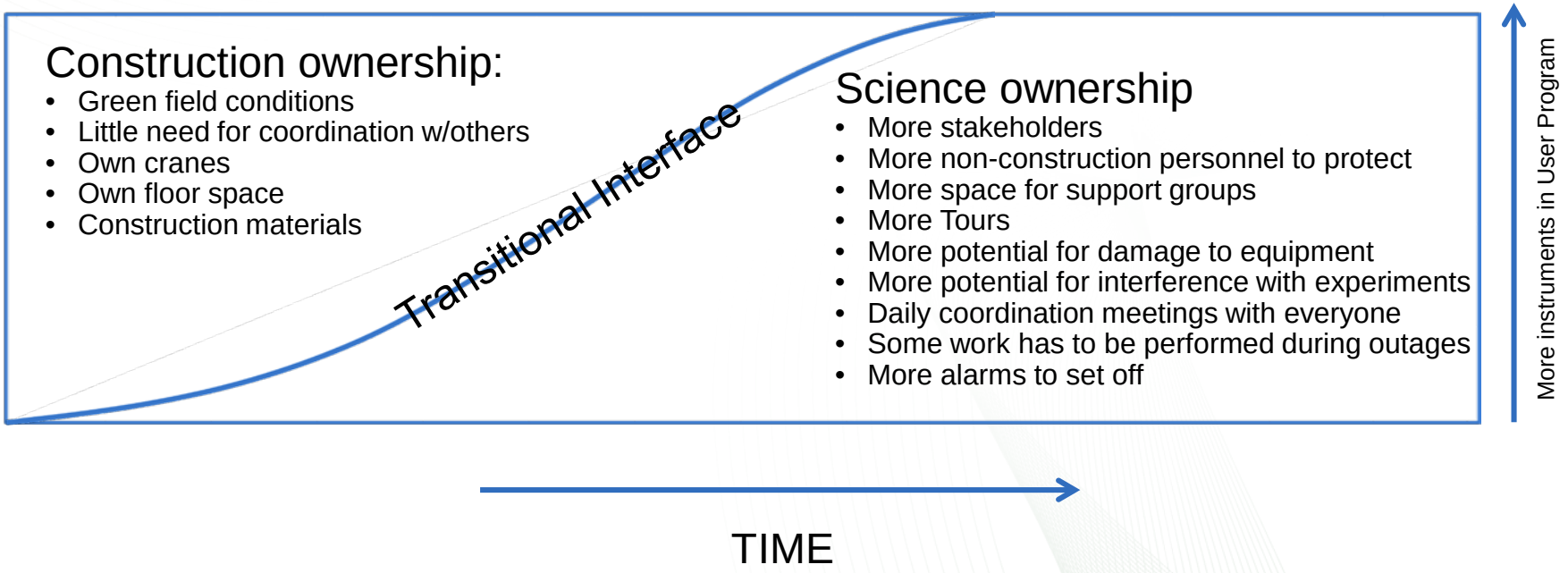
Cave shield walls

- Cave walls were constructed as in commercial construction,
  - With the exception that many were poured with High Density (HD) concrete.
  - HD concrete weighs approximately 245 pounds per cubic foot, vs. 125 pounds for regular density.
  - Walls to be poured with HD concrete had the studs spaced on 12” centers vs. 16”.

To produce smoother walls, no commercial forming was used.

Evolution of the workspace

Continuing awareness of boundaries

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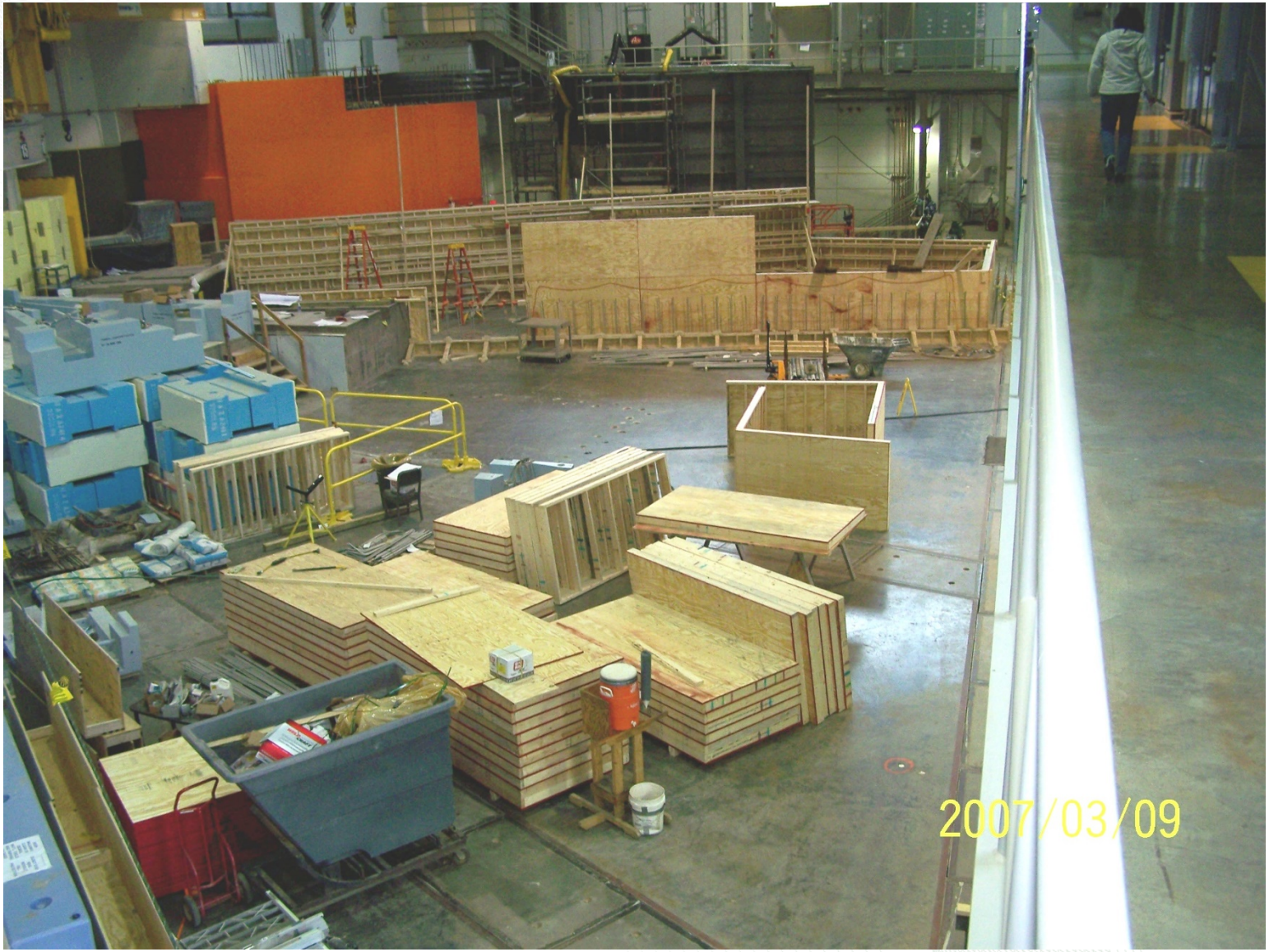


2006/12/08


2007/04/13


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CHOPPERS
Chopper
Maintenance
Facility
2009/01/06


DeSHAZO
CRANE COMPANY
CHOPPERS
2012/02/03

Working multiple instruments

- The number of instruments being worked simultaneously increased steadily until we were working our maximum of ten instruments at one time.
- Supervision was divided among the three supervisors and the group leader.
- The more instruments worked at one time, the easier it is to keep the craft numbers level:
  - To minimize bringing in and training new craft,
  - To keep from needing 10 Ironworkers one day and 30 the next,
  - Easier to keep a core of trained craft workers.

Communications

- Daily Experiment Hall Plan of the Day
  - All Experiment Hall entities represented
  - Coordination of work forces, locations and times
  - Cooperation on use of facility 30 ton overhead cranes
  - Pass-down of information and cautions
- Daily Installation Team meeting with subcontractor
  - Go over status of work
  - Plan for the next day
  - The Installation team and the subcontractor started work at 6:00 AM, engineers began work at 8:00
- Weekly Installation Team meeting – Group Leader and Instrument Supervisors
  - Share progress
  - Plan work and craft distribution for coming week
  - Share cross training
- Weekly Progress meeting – Installation Team, Instrument Engineers, and Project Manager
  - Discuss each task that is in progress
  - Give % complete, cost in craft hours, expected final cost

Issues and lessons learned

- Chopper base plate problems:
  - Installation team did not understand how much of a beating the chopper base plates would be subjected to.
  - No special instructions were given by engineers.
  - Team started out trusting “skill of the craft” for base plate grouting.
  - One of the T-Zero choppers loosened its base plate.
  - We pulled several T-Zero base plates and found inadequate fill on most.
  - We did a study on properly installing base plates and placing grout and developed a procedure and a verification form, and supervised each installation enforcing strict adherence to manufacturer’s instructions.
  - We also noted that if not properly supported a 1-1/2” plate will bow when walked on by the craftsman placing the grout and then draw back up when he gets off, leaving a gap.

Chopper base plate grouting

Installation and Grouting of Baseplates
Rev. 0; 05/05/16

1. Purpose: The purpose of this procedure is to provide guidance for installing grouted plates in a manner that will ensure that they will provide lasting and adequate support for structures and equipment, and for filling out the "Structural Grout Placement Inspection & Verification Report".
2. Scope: This procedure applies to all grouted baseplates and equipment bases, and to completion of the Structural Grout Placement Inspection & Verification Report.
3. Definitions:
   a. planner - Individual who plans the task (Note: planner is not capitalized because it is not an official position.)
   b. responsible engineer (Resp. Eng.) - UT-Battelle person who is responsible to ensure that the installation performs the required function for which it is intended, representing the customer (Also, not a position).
   c. Technical Tool Install Subcontractor - Company subcontracted to provide technical tool installation for SNS.
   d. Structural Engineer (Struct. Eng.) - UT-Battelle Structural Engineer, SNS Site Services Group.
   e. Installation Supervisor (Inst. Supv.) - UT-Battelle Installation Supervisor
   f. Subcontractor Superintendent (SC Supt.) - Technical Tool Install Subcontractor's Superintendent
   g. Installation Craft Foreman - Construction craft foreman directly responsible for the attribute to be verified
   h. Section C attributes:
      i. Plate/equipment Set - Sign-off indicates that the baseplate or equipment has been set to location for final alignment by Survey and Alignment team.
      ii. Final Alignment - Sign-off indicates that the Installation Supervisor has verified that the baseplate or equipment has been set to final alignment by Survey and Alignment team.
      iii. Forms - Sign-off indicates that the forms have been built to the specified shape and strength.
      iv. Clean - Sign-off indicates that the placement area is clean and free of debris.
      v. Meas'g Tools (Measuring Tools) - Sign-off indicates that the tools required for correct measuring components for the grout mixture are present.
   i. Witness - A person assigned to observe an attribute, condition, action or process to verify that it conforms to the specified requirements of the installation. Witnesses are assigned by the Structural Engineer.
4. Responsibilities:
   a. The planner shall initiate a *Structural Grout Placement Inspection & Verification Report* form (the Form), fill out Section A, and submit to the responsible engineer.
   b. The responsible engineer shall submit the Form to the Structural Engineer describing the use of the baseplate, or equipment.

Structural Grout Placement Inspection & Verification Report

Card Date:			Placement Date:		
Description of Placement:					
SRO Number:					
Components:					
Reference Documents:	Specification(s):	03300 Rev. 10			
	Contract Drawings:				
	Applicable Design Changes:				
Grout Specified:					
Mix (Circle):	Dry Pack	Plastic	Flowable	Fluid	Other*
*Other, specify					
lacement Method (Circle):	Dry pack	Pour	Pour w/head	Pump	Inject
Comments/Special Instructions:					

Preparation:	Equipment set	Final Alignment	Forms	Clean	Meas'g Tools
Iron Workers					
Inst. Supv.					
Carpenters					
Laborers					
SC Supt.					
(Circle): Circle specified cond.	Dry	Wet	Saturated Dry Surface		
Verify Cond. (Init./Date)					
Approved for Placement (Beam Line Installation Supervisor or Designee):					

Witness Mix (Circle):	SC Supt.	BL Supv.	BL Eng.	Struct. Eng.	Not Required
Witness Sign/Date:					
Witness Placement (Circle):	SC Supt.	BL Supv.	BL Eng.	Struct. Eng.	Not Required
Witness Sign/Date:					
Witness Comments:					

Issues and lessons learned

- Installation of beam stop mass into beam stop concrete was informally proceduralized.
- Direction was given directly on each of the first three.

Issues and lessons learned

- The fourth mass - the supports holding this 4700 pound mass collapsed, almost immediately after the mass was set on it.
- When the Ironworkers and the Operator were questioned about the setup. They said “That’s the way that we have always done it.” The Installation Supervisor did not disagree, nor were the workers thought to be untruthful.
- The work began on the fourth 1-1/2 years after the third was installed it was begun in a different way. The Installation Supervisor had not reviewed the previous installations with them, nor was he present.
- Our memories cannot be counted on.

Mass slowly collapsed when touched by S&A technicians. No one was injured.

We typically kept a core of above 40 craft workers and peaked at about 80. These two Ironworkers, three Electricians and one Operator worked on the Technical Tool Installation Subcontract for twelve years, first in the klystron gallery and linac and then on instrument installation.

They were celebrated and laid off the day this picture was taken.

Installation of nineteen instruments took approximately eight years.

Thank you for your attention.