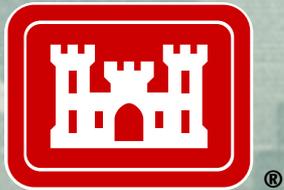


Webbers Falls and Ozark Powerhouse Major Rehabilitation

Briefing for 2011 Southwestern Federal Hydropower Conference

Dan Brueggjenhann - Project Manager
Programs & Project Management
Division
Tulsa District

14 June 2011



US Army Corps of Engineers
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Background

- **Run of River Plants**
- **Webbers - 69 MW from three inclined axis units (23 MW each) which were placed in service in 1973. Average annual energy production is 213,000 Megawatt-hours.**
- **Ozark – 115 MW from five inclined axis units (23 MW each) which were placed in service in 1974. Average annual energy production is 429,000 Megawatt –hours.**



Webbers Falls Project Scope, Cost and Schedule

- **Project Scope:** Rehabilitation of the Webbers Falls Powerhouse to include replacement of three turbines, the rewinding of three generators (up rate of 8%) and rehabilitation of all cranes, tailrace and intake gates and bulkheads.
- **Rehabilitation Evaluation Report approved in July 2001.**
- **Project Cost including management expenses: \$72.7M (\$67.9M Customer Funded)**
- **Scheduled Completion Date:**

October 2014



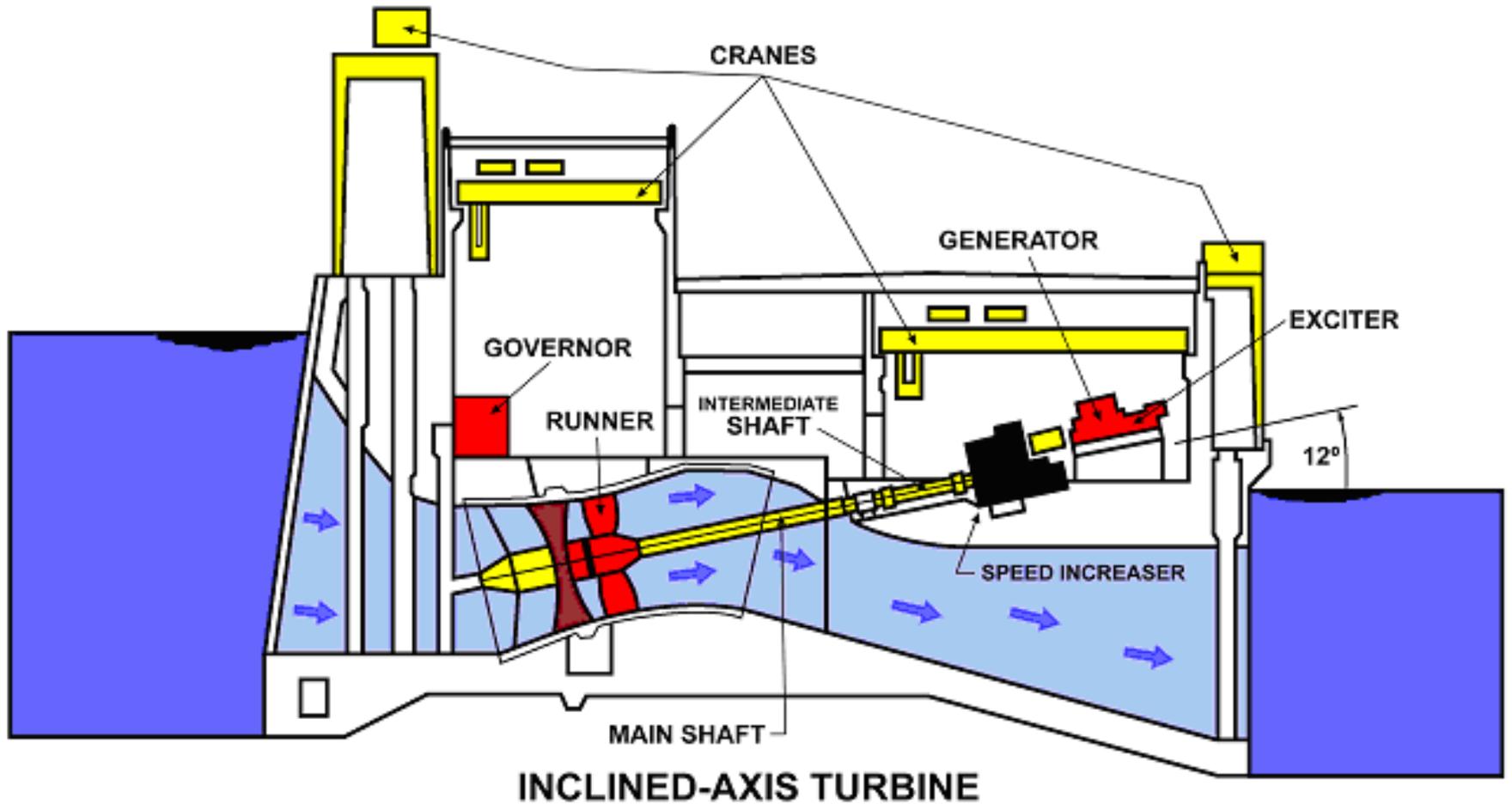
Ozark Project Scope, Cost and Schedule

- **Project Scope: Rehabilitation of the Ozark Powerhouse to include replacement of five turbines, low speed gears, rehabilitation the cranes, generator air coolers and other miscellaneous components.**
- **Rehabilitation Evaluation Report approved in July 1999**
- **Project Cost including management expenses: \$115.3M**
- **Scheduled Completion Date: December 2015**

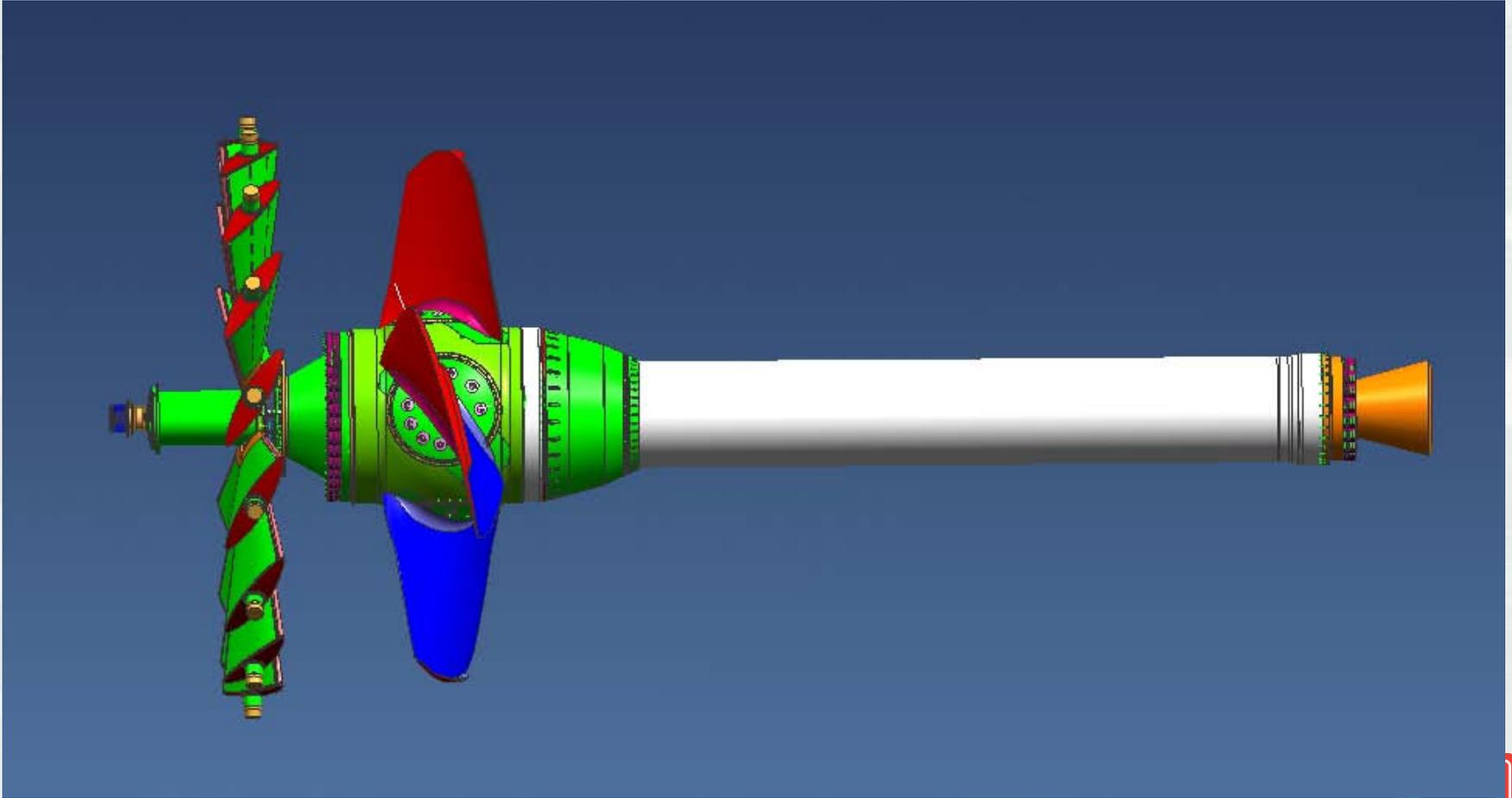


Background – cont.

Cut View of the Powerhouse



New Runner Design



Turbine Rehab Schedule

Task Name	Duration	Start	Finish	2007	2008	2009	2010	2011	2012	2013	2014	2015	
OZ Unit 4	924 days	Thu 11/15/07	Wed 6/1/11		[Red bar spanning 2008, 2009, 2010, and 2011]								
OZ Unit 2	576 days	Fri 4/9/10	Mon 6/25/12				[Red bar spanning 2010 and 2011]						
OZ Unit 1	456 days	Thu 6/2/11	Wed 2/27/13					[Red bar spanning 2011 and 2012]					
OZ Unit 3	456 days	Tue 6/26/12	Mon 3/24/14						[Red bar spanning 2012 and 2013]				
OZ Unit 5	458 days	Wed 3/26/14	Fri 12/25/15								[Red bar spanning 2014 and 2015]		
WF Unit 3	602 days	Wed 3/25/09	Thu 7/14/11			[Red bar spanning 2009 and 2010]							
WF Unit 2	457 days	Mon 7/18/11	Mon 4/15/13					[Red bar spanning 2011 and 2012]					
WF Unit 1	390 days	Thu 4/18/13	Wed 10/15/14							[Red bar spanning 2013, 2014, and 2015]			

Original Ozark Contract Completion Date: October 7, 2012

Original Webbers Falls Contract Completion Date: June 10, 2012

Ozark Expected Completion Date: December 2015

Webbers Falls Expected Completion Date: October 2014

- Notice improvement on 2nd unit, 42 months down to 27 months.
- 21 months/unit at OZ and 18 months/unit at WF.
- Longer time at OZ due to working on two units simultaneously and governor work.

**Disassembly
4 months**

**Rehab Water Passage
6 months**

**Reassembly/Commission
8 months**



Webbers Falls Total Cost Breakdown

2010 Current Cost Est. - \$72.7M

Turbine Rehab Cont. - 55.3

Generator Rewind Cont - 6.0

Intake/Draft Tube Cranes – 4.0*

Rehab Two Bridge Cranes – 2.6

Intake Gates & Bulkheads - 4.0**

New 13.8KV Breakers - 0.8*

Total - \$72.7M

* ARRA Funded ** Partial ARRA funded

Cost include administration and contingency



Webbers Project Status – Sub Agreements

- **Sub agreement S127 Unit 3 Turbine for \$19.5M signed 15 August 2007.**
- **Sub agreement S131 Unit 2 Turbine for \$17.9M signed 11 January 2008.**
- **Sub agreement S135 Unit 1 Turbine for \$17.9M signed 21 April 2008.**
- **Total Turbine Rehab - \$55.3M**



Webbers Additional Sub Agreements

SW00431-S138 – Rewind Generators

Units 1,2 & 3 = \$6.0M

Contract Awarded - \$4.96M

SW00431-S092- Rehab Bridge Cranes - \$2.62M

Actual Expenditures – \$2.606

Contract Complete

SW00431-S088- 13.8KV Circuit Breakers - \$320K

Contract Awarded - \$787K through ARRA

SW00431-S137- Misc Mech and Electrical - \$4M

Contract Awarded – 3.56M

\$518K funded through ARRA



Webbers Turbine Rehab Sub Agreement Funding

	Unit 3	Unit 2	Unit 1
Contracts & Modifications	\$16,066,259	\$14,576,932	\$14,552,000
S&A/EDC	\$1,481,000	\$1,154,000	\$925,000
Contingencies	\$1,952,741	\$2,169,068	\$2,423,000
Sub Totals	\$19,500,000	\$17,900,000	\$17,900,000

Total Contingencies = \$6.54M

Est. Additional Escalation = \$3.66M

Current Estimated Surplus = \$2.99M



Webbers Turbine Runner 3 Schedule

- Reassembly – Jun 10 - Jul 11
- Dry commissioning – 15 Jul 11
- Initial water up - 25 Jul 11
- Testing & Acceptance – 8 Aug 11

Webbers Turbine Runner 2 Schedule

- Runner Manufacturing – 80% Complete
- Shaft Manufacturing - Complete
- Wicket Gate Manufacturing - Complete
- Disassembly – Sep 11- Sep 12
- Reassembly – Sep 12 – Apr 13
- Testing & Acceptance – 15 Apr 13



Ozark Funding Status

• Ozark Rehab Project Estimate -	\$115.3M
– Cranes, Gates, Generator Coolers, Plant Prep-	\$3.5M
– Turbine Contract (includes known mods)	\$95.0M
– Engineering, Project Support, Contract Mgmt-	\$8.5M
– Contingency	\$7.3M
• Funding Received to Date-	\$94.4M
– Regular Appropriations-	\$44.6M
– Recovery Act Funding	\$29.7M
– Customer Funding	\$20.1M
• Balance To Complete-	\$20.9M



Ozark Funding Status

- **FY 12 Funding-**
 - **\$0 in President's Budget**
 - **Additional funds will be required by 4th Quarter**
 - **Preparing a Sub-agreement for supplemental customer funding \$13.5M FY 12 requirement**



Ozark Turbine Runner 4 Schedule

- Reassembly – Complete
- Governor Commissioning – Ongoing
- Realigning Servomotors – Ongoing
- Water up – July 8 2011
- Testing & Acceptance – 28 July 11

Ozark Turbine Runner 2 Schedule

- Reassembly – Ongoing
- Complete stainless steel overlay - 28 June 11
- Gate assembly installed – 19 Nov 11
- Runner blades installed – 1 April 12
- Testing & Acceptance – 25 June 12



Major Challenges

- **Gate Barrel Removal**
- **Wicket Gate Assembly**
- **Runner Installation**
- **Runner/Lower Shaft Alignment**
- **Turbine Alignment**
- **Rejection of Finished Parts**
- **Lubrication System Flushing**

Ozark/Webbers Falls Major Rehab



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Gate Barrel Removal

Problems

- 150 ton crane vs. 163 ton load
- Wedged in with 40 years of Gunk
- Forgotten Trash Deflectors

Solutions

- Pre and post crane engineering inspections
- 250 Ton Ram Assistance
- Trash deflector cutting

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Gate Barrel Removal - Pics



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Wicket Gate Assembly

Problem

- **Interference between new wicket gates and gate barrel**
- **Air lock between seals prevented gates from fitting**

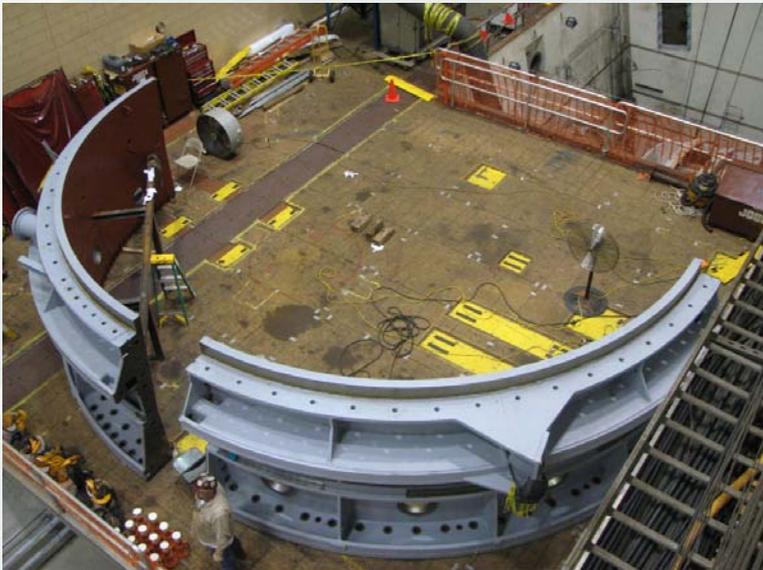
Solution

- **Spotface was machined on site - new units to be machined at the shop**
- **Air holes drilled and then plugged after wicket gate installation (Webbers)**

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Wicket Gate Photos



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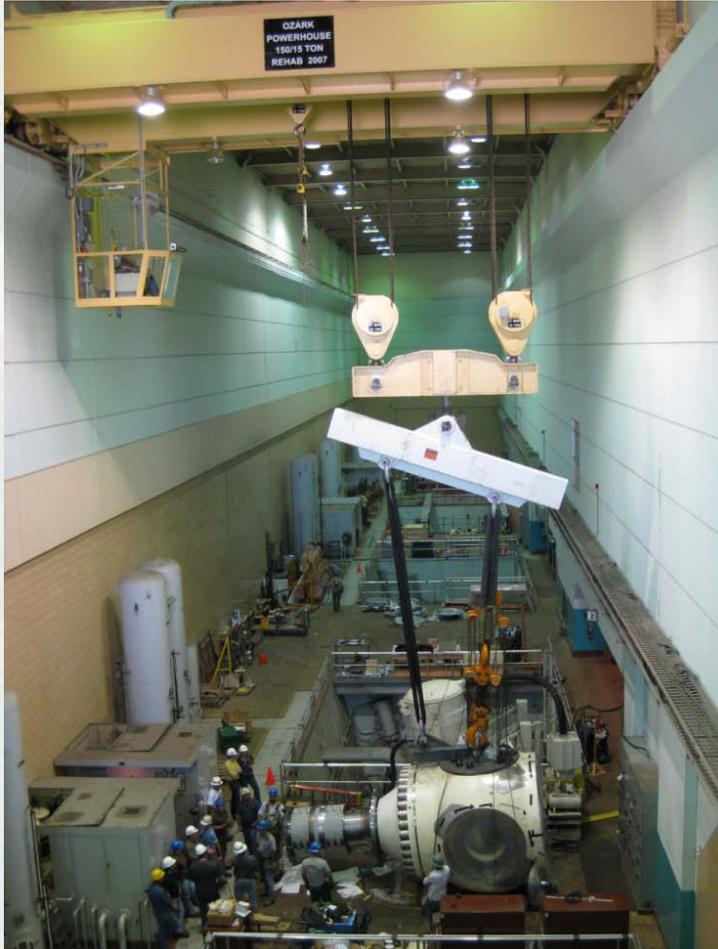
Runner Installation

Problem:

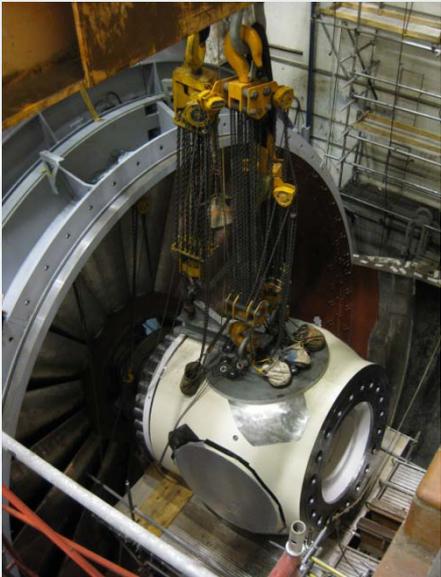
- **Runner was designed with stub shaft attached. Unit must be lowered 90 degrees off and then rotated in.**
- **Runner must be tipped and inserted into a 12 degree hole.**
- **Contractor was to design lifting device.**



Runner Installation – Early Attempts



Solution: Successful Runner Installation



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Runner/Lower Shaft Alignment

Problem:

- Design change includes shear sleeves
- Connection requires aligning bores in runner hub & lower Shaft made in different countries to $\pm 0.002''$
- Adjustment of runner hub (about 100 tons) or lower shaft (about 70 tons) extremely difficult.

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Runner/Lower Shaft Alignment

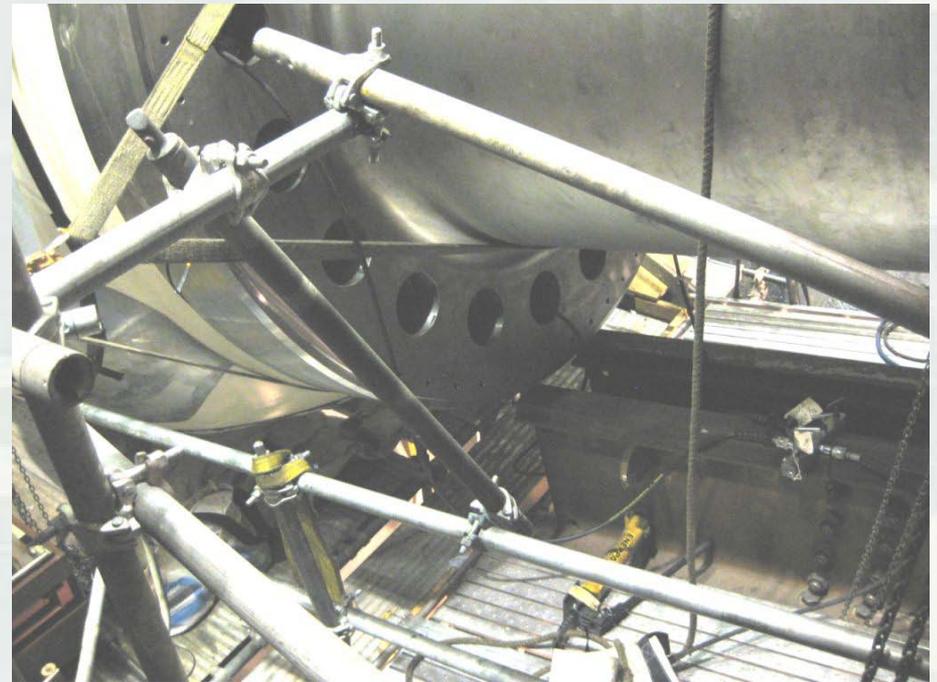
Solution:

- **Initial assembly required line boring**
- **Use of hydraulic jacks in three holes aligned both pieces of equipment.**
- **Only honing required at Webbers**

Ozark/Webbers Falls Major Rehab

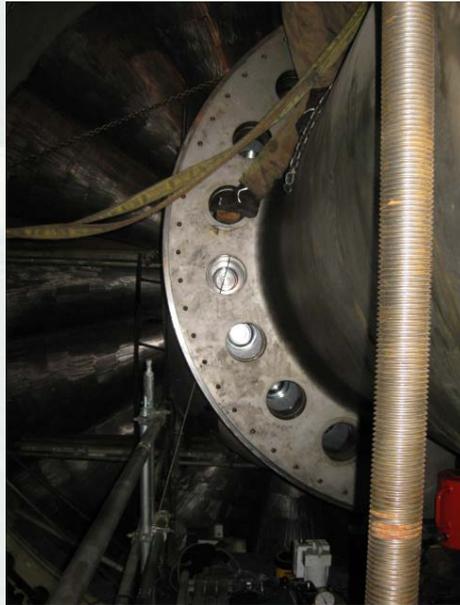


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Runner/Lower Shaft Alignment



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Commissioning Is a Joint Effort

- **At Ozark the commissioning process is a joint effort between Andritz Hydro, the COE District Test Crew, Ozark Powerhouse personnel, and COE Construction Management. A commissioning planning meeting was held on March 18 at Ozark.**
- **At Webbers Falls the commissioning process is a joint effort between Andritz Hydro, the COE District Test Crew, American Governor, Webbers Falls Powerhouse personnel, and COE Construction Management. A commissioning planning meeting was held on May 4 at Webbers Falls.**



Commissioning Procedures

Commissioning procedures submitted and approved:

- Stub Shaft Lube System
- Main Shaft Bearing
- Oil Head Leakage System
- Cooling Water System
- Speed Increaser
- Governor Hydraulic System
- Digital Governor Control System
- Dry Testing
- Initial Water Up
- Cathodic Protection System
- First Run
- Bearing Run
- Offline Testing
- Online Testing



Questions



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