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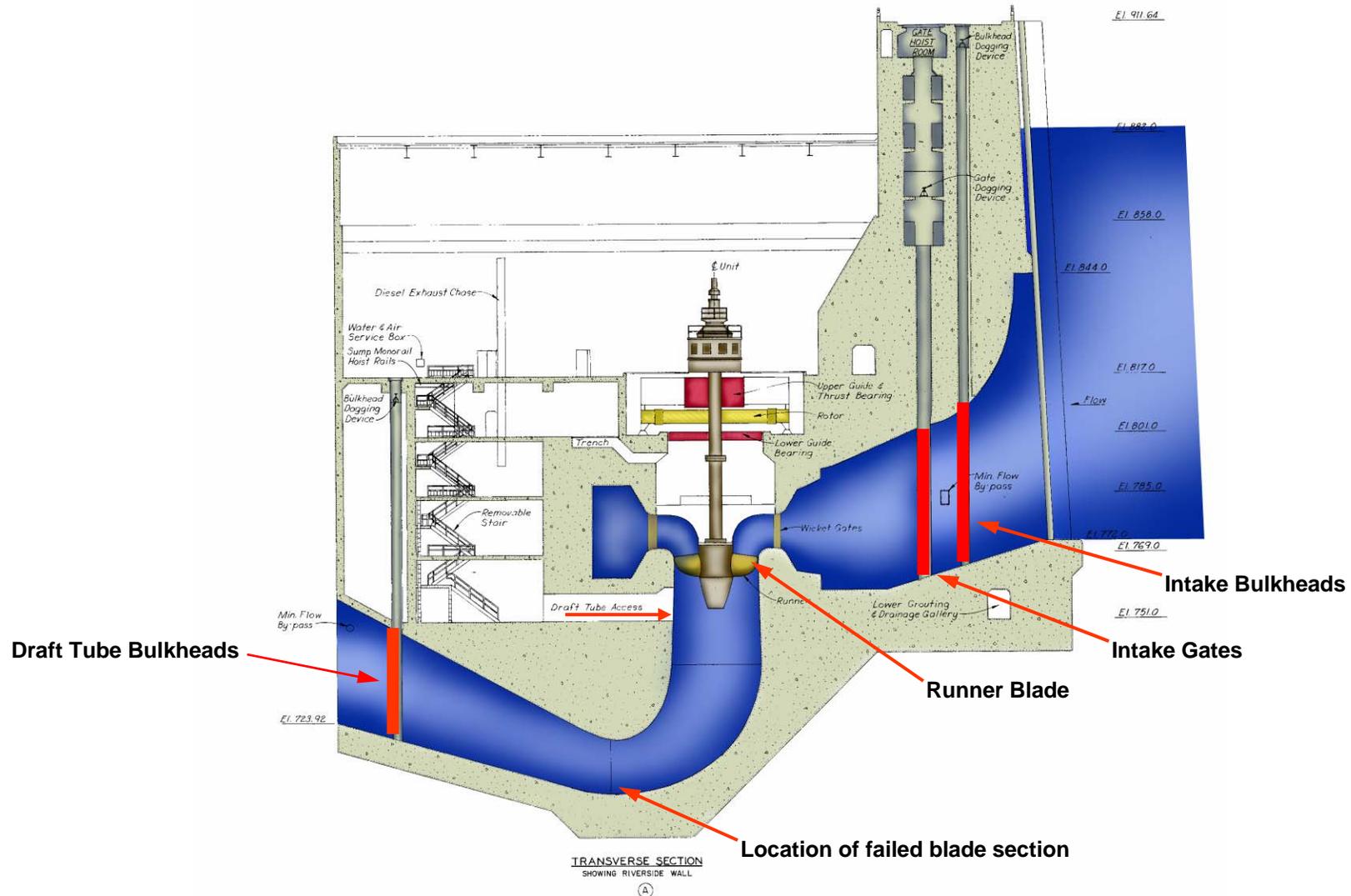
# Stockton Turbine Blade Failure



**BUILDING STRONG**



## Stockton Power Plant Cross Section





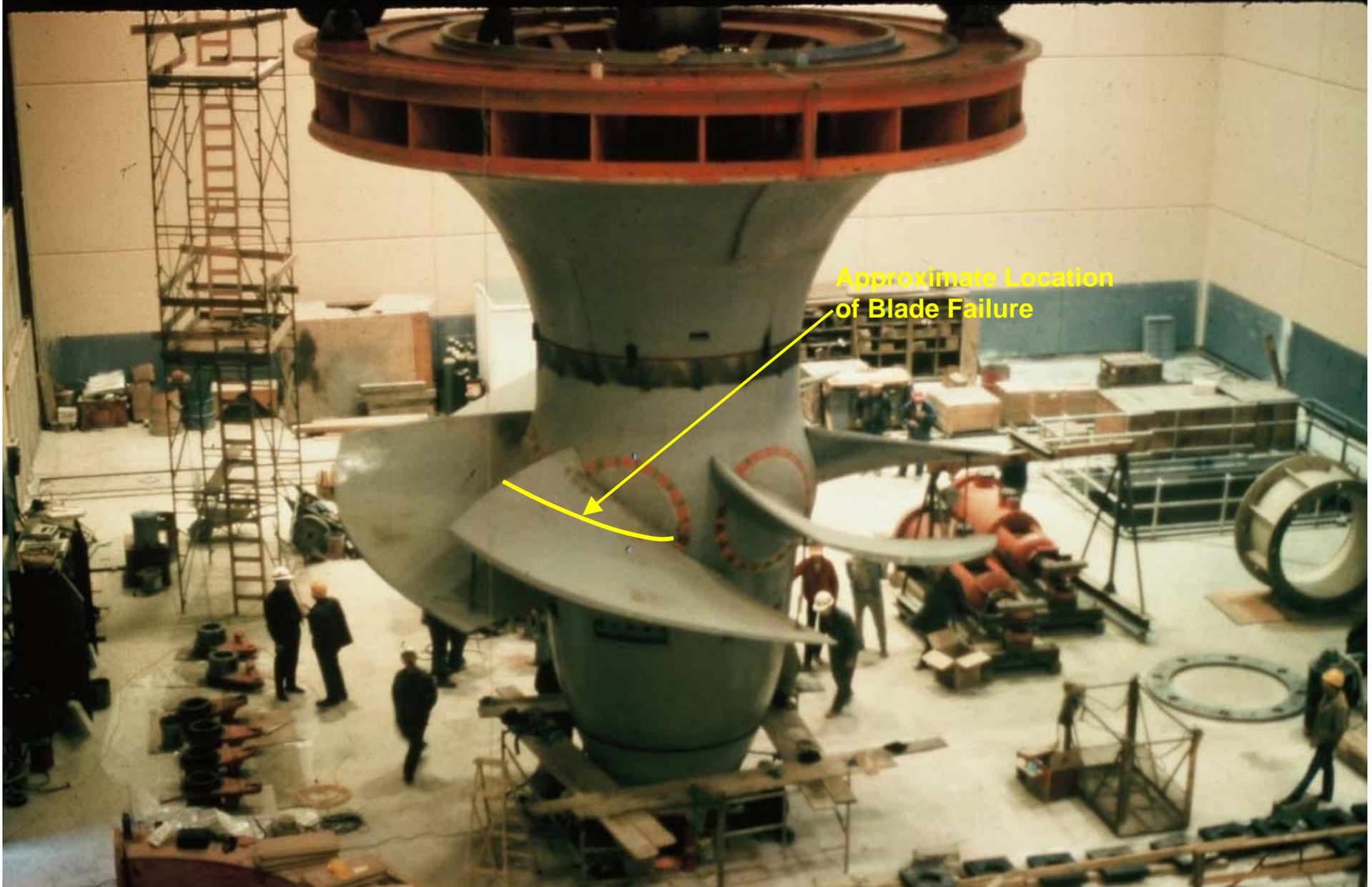
## Runner Blade Failure

- Unit experience severe vibration the morning of 4 Feb 09 activating the vibration alarms
- Plant personnel observed cyclic banging and water leakage at the draft tube hatch door
- Unit was immediately shut down
- A failed blade section (blade #4) was discovered by divers at the bottom of the draft tube
- Partial dewatering was performed to inspect turbine runner
- Turbine blade #4 experienced a catastrophic failure
- Potential cracks were observed on three of the other five blades (blades #2, #5, and #6)





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Approximate Location  
of Blade Failure



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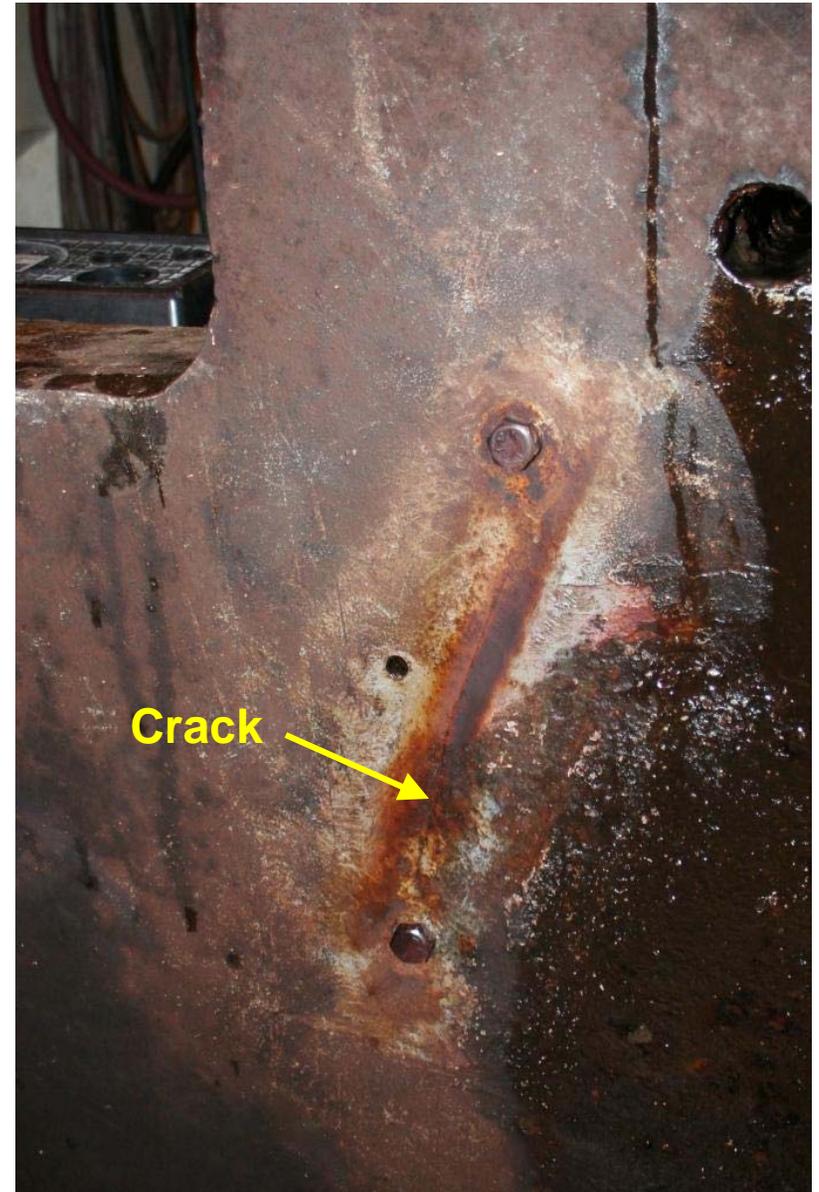


Draft Tube Hatch Door  
Elev. 751.0



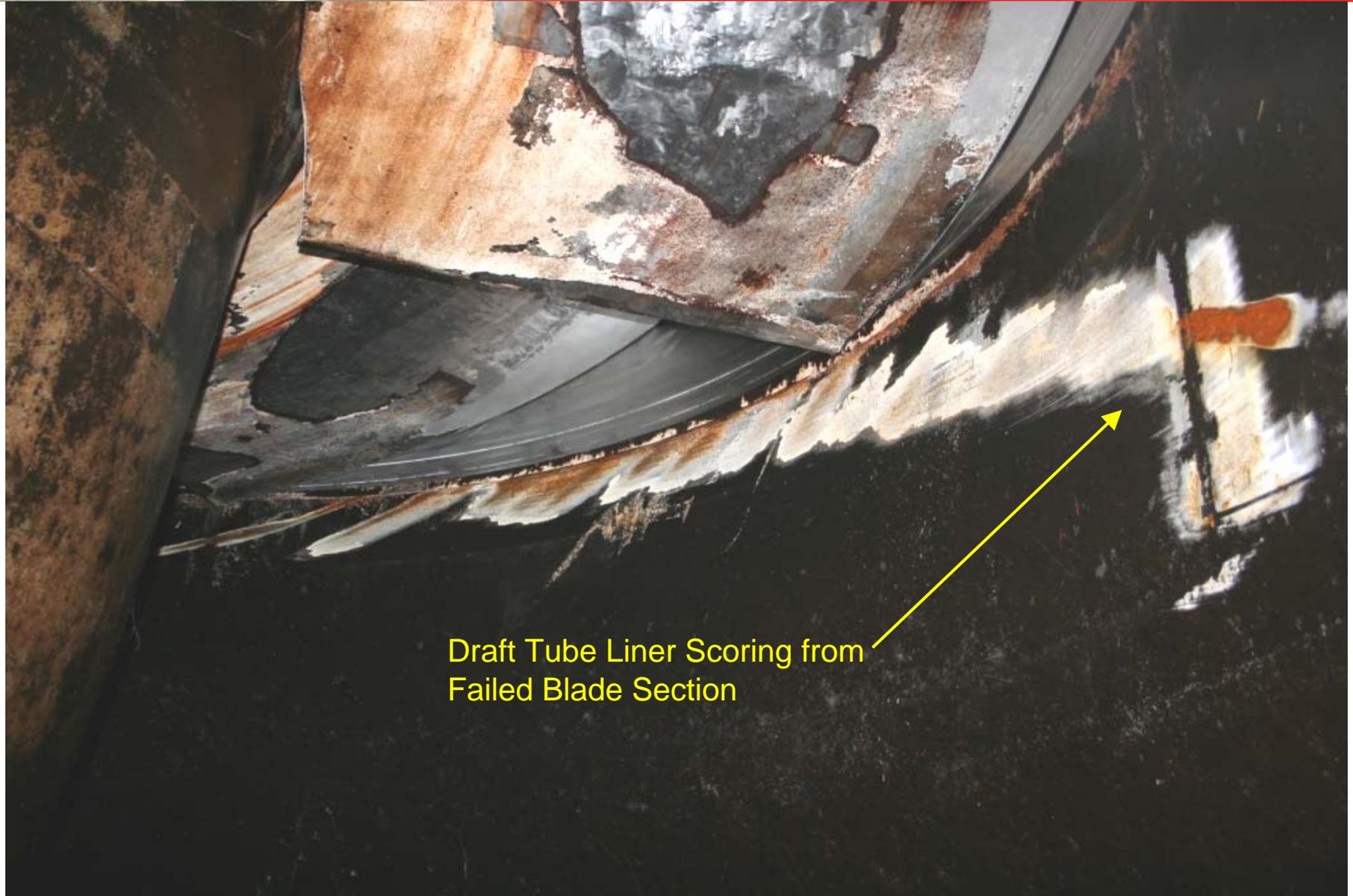
## Draft Tube Liner Crack

- Crack discovered and mitigated in April 2008
- Two holes were drilled at the ends of the crack and two bolts installed
- Still need to perform permanent weld repair
- Crack will be repaired as part of the in-place blade repair contract





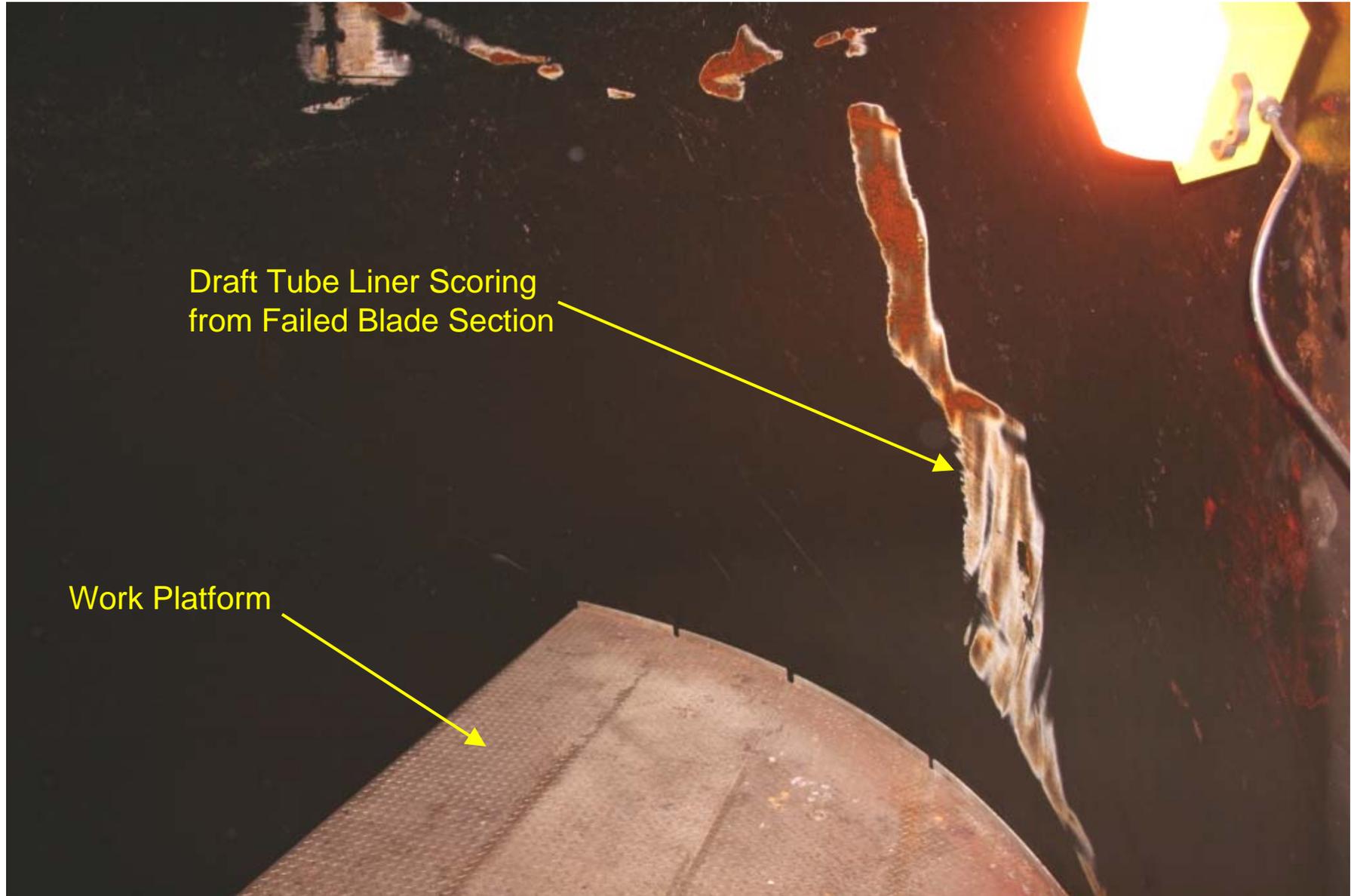
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Draft Tube Liner Scoring from Failed Blade Section



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Draft Tube Liner Scoring  
from Failed Blade Section

Work Platform

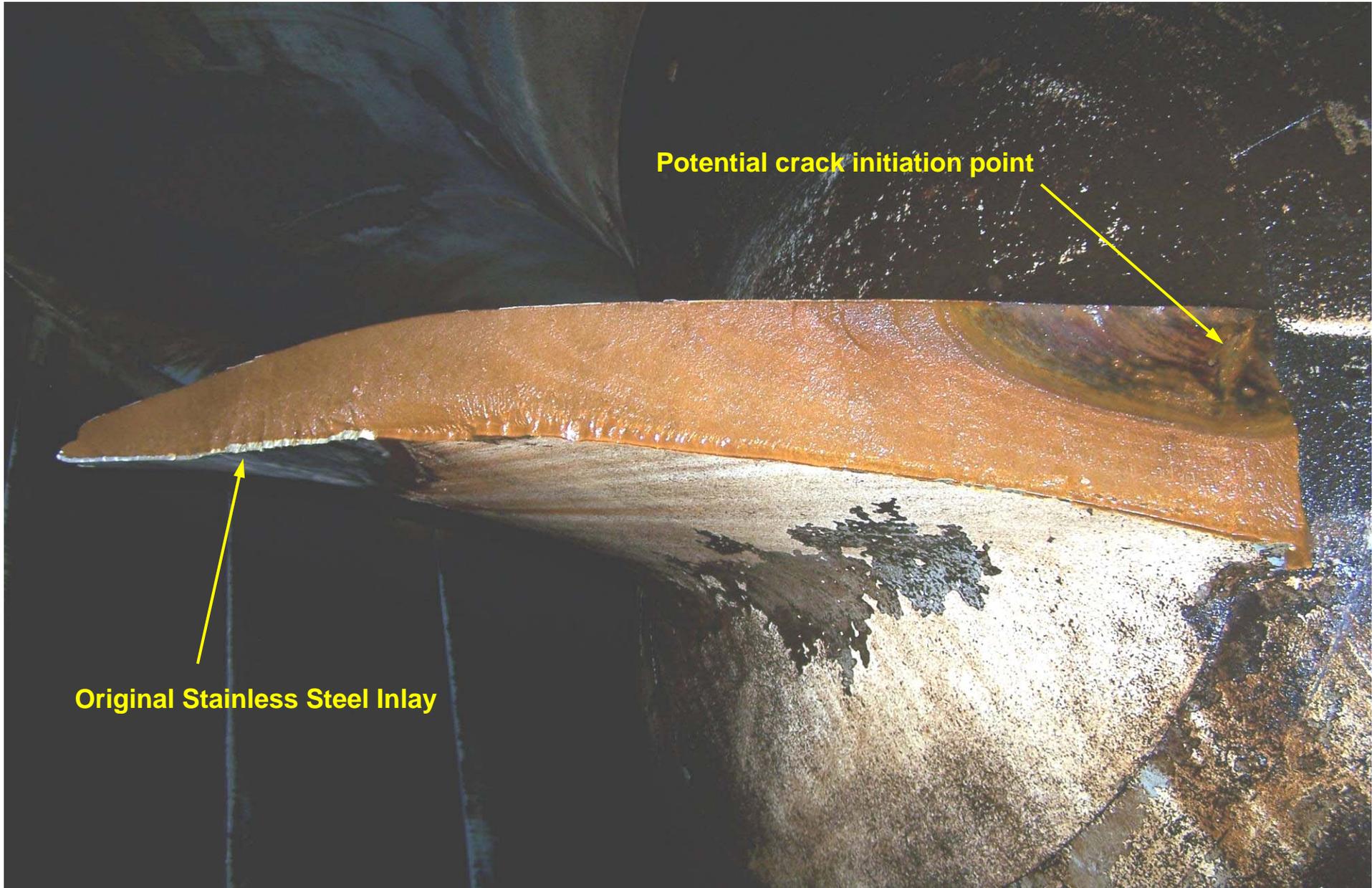


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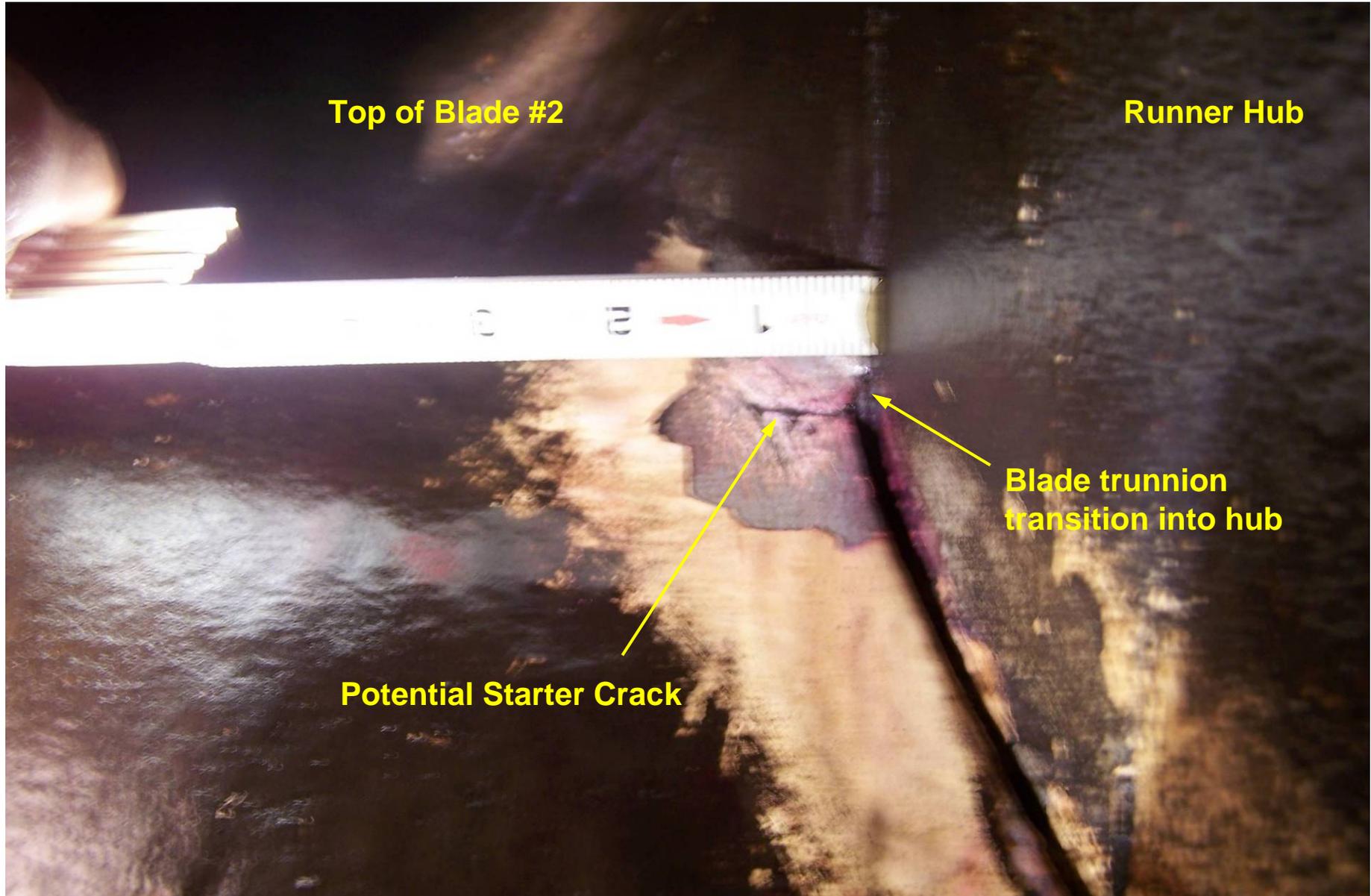
Potential crack initiation point

Original Stainless Steel Inlay





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# Course of Action

- Repair/Inspect Hydraulic Steel Structures (Bulkheads/Intake Gates): **Critical Path**
- Recover Failed Blade Section from Draft Tube
- Inspect Draft Tube, Runner Hub, Blades, etc.
- Perform In-Place Blade and Draft Tube Liner Crack Repair
- Perform Major Turbine/Generator Rehab Work



# ARRA Funding

Work Package	Costs
Blade Recovery	\$75,000
HSS Inspection/Repair	\$925,000
Governor Digital Control Retrofit	\$1,500,000
Transformer Replacement	\$9,000,000
Turbine Repair/Replacement	\$17,475,000
Generator Rewind	\$5,000,000
<b>Total</b>	<b>\$33,975,000</b>

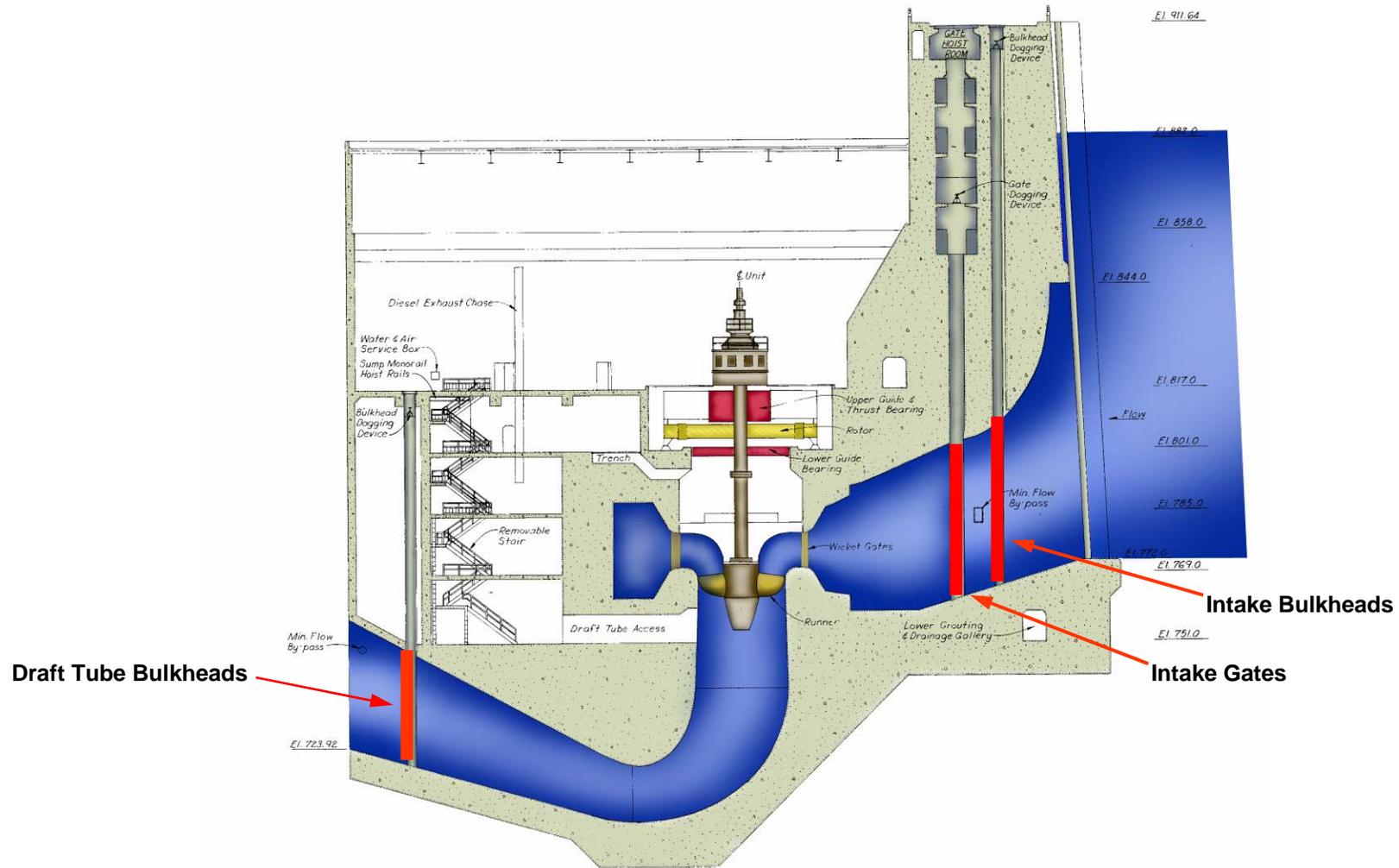


# HSS Inspection/Repair

- Work includes weld inspection/repair of the intake gates and intake and draft tube bulkheads
- Schedule
  - Complete P&S: 8 June 09
  - Advertise Contract: 10 June 09
  - Award Contract: 2 July 09
  - Contract Completion: 15 Jan 10
- Defective welds found during intake gate inspection may increase contract period



## HSS Inspection/Repair Work



TRANSVERSE SECTION  
SHOWING RIVERSIDE WALL

A



## Draft Tube Bulkheads

- Total of 3 draft tube bulkheads
- Each draft tube bulkhead consists of two bolted sections that will require disassembly
- Two draft tube bulkheads (middle and riverside) require weld repair and all three will require additional NDT of fracture critical welds
- 98 linear feet of weld repair on middle DTB and 14 linear feet of weld repair on riverside DTB
- Work also includes sandblasting and painting of weld inspection and repair areas and J-bulb seal replacement



## Intake Bulkheads

- Total of 3 intake bulkheads
- Mobile crane required to remove/install bulkheads
- All three intake bulkheads require weld repair
- 50 linear feet of weld repair for all three bulkheads
- Work also includes sandblasting and painting of weld repair areas and J-bulb seal replacement



## Intake Gates

- Total of 3 intake gates
- All three intake gates require weld inspection
- Inspection work will be performed onsite within the intake gate chamber
- Intake bulkheads must be repaired before intake gates can be inspected
- All three intake bulkheads must be installed to dewater the area upstream of one intake gate
- Work will also include replacement of anodes and weld repair if defective welds are found



# Blade Recovery

- Work includes underwater recovery of failed blade section using divers
- Schedule
  - Complete P&S: 15 May 09
  - Request Contractor Bid (sole source): 18 May 09
  - Award Contract: 23 Jun 09
  - Contract Completion: Aug 2009



## In-Place Blade Repair

- Work includes weld repair of failed blade section, NDT/repair of the other five blades, and repair of the draft tube liner crack
- Schedule
  - Complete P&S: 15 Jul 09
  - Advertise Contract: 30 Jul 09
  - Award Contract: 18 Sep 09
  - Contract Completion: May 2010
- Estimated Repair Costs: \$500K - \$600K
- Average monthly capacity and energy value lost is \$630K justifying the in-place blade repair
- HSS inspection/repair work must be completed before onsite work can start



# Major Turbine/Generator Work

- Work will be broken up into three major contracts
  - Transformer Replacement
  - Turbine Replacement/Generator Rewind/Ancillary Equipment Replacement
  - Switchgear & Controls Replacement
- Separate asbestos abatement/removal contract may be required
- Asbestos survey will be conducted at the plant in late June 09



# Transformer Replacement

- Work includes the development of P&S, award of a supply contract, and delivery of the transformer
- Schedule
  - Complete P&S (HDC): 24 Jun 09
  - Advertise Contract: Jul 2009
  - Award Contract: Sep 2009
  - Contract Completion: Sep 2011
- Transformer installation will be included under the Switchgear & Controls Replacement Contract



## Turbine Replacement/Generator Rewind/Ancillary Equipment

- Work includes the development of P&S; design, model testing, and manufacturing of new turbine runner; generator rewind; and replacement/refurbishment of ancillary equipment
- Schedule
  - Complete P&S (HDC): July 2009
  - Advertise Contract: Aug 2009
  - Award Contract: Dec 2009
  - Turbine Runner Design/Model Testing: Jan – Dec 2010
  - Turbine Runner Manufacturing: Jan 2011 – Dec 2012
  - Disassembly/Gen Rewind/Gen Work/Reassembly: Aug 2012 – Aug 2013
  - Equipment Testing/Commissioning: Sep – Oct 2013
  - Contract Completion: Nov 2013



## Switchgear & Controls Replacement

- Work includes the development of P&S; contract advertisement/award; switchgear/controls replacement; emergency generator replacement; installation of transformer and secondary containment; exciter replacement; G/M breaker replacement; etc.
- Schedule
  - Complete P&S (HDC): Early Oct 2009
  - Advertise Contract: Late Oct 2009
  - Award Contract: Dec 2009
  - Switchgear/Controls Design: Jan – Dec 2010
  - Switchgear/Controls Manufacturing: Jan 2011 – Jun 2012
  - Design/Installation of Trans/Sec Containment: Jan 2010 – Aug 2012
  - Switchgear/Controls Installation: Aug 2012 – Aug 2013
  - Equipment Testing/Commissioning: Sep – Oct 2013
  - Contract Completion: Nov 2013



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**Questions???**