LEASONS LEARNED FOR
AXIAL/MIXED
FLOW PROPELLER PUMPS
Construction, Design Issues and Problems
Some lessons learned:

Get involved with construction activities
Design Criteria

- Get involved with construction activity from shop drawing review to final field inspection
Design Criteria

- Get involved with construction activity from shop drawing review to final field inspection
- Develop good working relationship with Construction Office
Get involved with construction activity from shop drawing review to final field inspection

Develop good working relationship with Construction Office

Demonstrate to them how important your input is
Design Criteria

- Include your involvement in the Engineering Construction Instructions (ECIs)
Design Criteria

- Include your involvement in the ECIs
- Make your presence known in shop/field
Design Criteria

- Include your involvement in the ECIs
- Make your presence known in shop/field
- Ask questions
Need Effective CQC Program

- Enforce Contractor Quality Control program
Need Effective CQC Program

- Enforce Contractor Quality Control program
- Get to know Quality Control person for pump manufacturer
Need Effective CQC Program

- Enforce Contractor Quality Control program
- Get to know Quality Control person for pump manufacturer
- Review Contractor Quality Control plan
Need Effective CQC Program

- Enforce Contractor Quality Control program
- Get to know Quality Control person for pump manufacturer
- Review Contractor Quality Control plan
- Ensure Contractor Quality Control plan includes pump manufacturer activities
Need Effective CQC Program

- Require preparatory inspection for pump manufacture
Need Effective CQC Program

- Require preparatory inspection for pump manufacture
- Attend Preparatory and Initial Inspections
Need Effective CQC Program

- Require preparatory inspection for pump manufacture
- Attend Preparatory and Initial Inspection
- Review Follow-up inspection reports
Contract Requirements

- Read and understand contract specifications (technical and nontechnical).
Bottom of Impeller Hub Pump #2
(Note: Weights Welded in Hub)
Contract Requirements

- **Read and understand contract specifications (technical and nontechnical).**

- **Read and understand referenced industry standards**
Contract Requirements

- Read and understand contract specifications (technical and nontechnical).
- Read and understand referenced industry standards
- Obtain copy of referenced industry standards
**Contract Requirements**

- **Read and understand contract specifications (technical and nontechnical).**
- **Read and understand referenced industry standards**
- **Obtain copy of referenced industry standards**
- **Ask to see contractors copy of industry standards**
Be familiar with the shop drawings.
Shop Drawings

- Be familiar with the shop drawings.
- Ensure contractor has approved shop drawings on-site
Shop Drawings

- Be familiar with the shop drawings.
- Ensure contractor has approved shop drawings on-site
- Check that shop and manufacturing drawings agree
Shop Drawings

- Be familiar with the shop drawings.
- Ensure contractor has approved shop drawings on-site
- Check that shop and manufacturing drawings agree
- Check manufacture in accordance with shop/manufacturing drawings
Review/Witness Assembly Procedures

- Witness Factory Assembly
Review/Witness
Assembly Procedures

- Witness field assembly
Factory/Field Tests

- Check calibration of testing equipment.
Impeller #2 on Balance Machine
Factory/Field Tests

- Check calibration of testing equipment.
- Review testing procedures
Factory/Field Tests

- Check calibration of testing equipment.
- Review testing procedures
- Attend factory test
Factory/Field Tests

- Check calibration of testing equipment.
- Review testing procedures
- Attend factory test
- Attend field tests
HELP!!!!

- Ask for help from other Corps offices or Headquarters in Washington DC
HELP!!!!

- Ask for help from other Corps offices or Headquarters in Washington DC
- Why is this important?
HELP!!!!

- **Pumps are complex, built to close tolerances, requiring highly skilled craftsmen**
HELP!!!!

- **Pumps** are complex, built to close tolerances, requiring highly skilled craftsmen.

- **Pumps** are a combination of castings (impeller), forgings (shaft), and weldments (column).
HELP!!!!

- Each pump is built independently, specifically for your project
Each pump is built independently, specifically for your project

Quality of construction will determine success or failure of pump
Quality of Construction

Quality of construction depends on:
Quality of Construction

- Skill level of workers, i.e., machinists, foundry workers, and welders.
Quality of Construction

- Skill level of workers, i.e., machinists, foundry workers,
- Built in accordance with shop drawings, manufacturing drawings
Quality of Construction

- **Skill level of workers, i.e., machinists, foundry workers,**
- **Built in accordance with shop drawings, manufacturing drawings**
- **Cleanliness of shop**
Quality of Construction

- **Skill level of workers, i.e., machinists, foundry workers,**
- **Built in accordance with shop drawings, manufacturing drawings**
- **Cleanliness of shop**
- **Assembly/disassembly procedures**
Quality of Construction

- Storage and Handling of equipment/components on-site (factory or field)
Impeller #1 After Balancing
(Note: Weights inside Hub)
Quality of Construction

- Storage of equipment/components on-site (factory or field)
- Proper material selection, quality standards
What Can Go Wrong?
What Can Go Wrong?

Seized or Damaged Bearings
What Can Go Wrong?

Seized or Damaged Bearings:
- Improper clearance
What Can Go Wrong?

Seized or Damaged Bearings:

- Improper clearance
- Wrong surface finish
What Can Go Wrong?

Seized or Damaged Bearings:
- Improper clearance
- Wrong surface finish
- Shaft misalignment
What Can Go Wrong?

Seized or Damaged Bearings:
- Improper clearance
- Wrong surface finish
- Shaft misalignment
- Bearing misalignment
What Can Go Wrong?

Seized or Damaged Bearings:
- Improper clearance
- Wrong surface finish
- Shaft misalignment
- Bearing misalignment
- Incorrect or no lubricant
What Can Go Wrong?

Seized or Damaged Bearings cont:

- Imbalance of Impeller or Propeller
What Can Go Wrong?

Seized or Damaged Bearings cont:

- Imbalance of Impeller or Propeller
- Contamination by sand, silt or other foreign materials within the shaft or bearing housing
Pump Design

- Operate at resonant frequency between the pump and motor can cause vibrations and damage the pump.
Pump Design

- **Operate at resonant frequency between the pump and motor** can cause vibrations and damage the pump.
- **NPSHR > NPSHA**
Pump Design

- **Operate at resonant frequency between the pump and motor can cause vibrations and damage the pump.**
- **NPSHR > NPSHA**
- **Fail performance and/or cavitation test**
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