Normetex Pump Replacement

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Tritium Facilities
Objectives

• Determine specific pump requirements

• Evaluate alternatives to the Normetex pump

• Short-term Actions
  (in-house activities until a new pump is available)

• Proposed Path Forward
Normetex Background

- Normetex is truly a unique pump - the Met-Bel / Normetex pump train provides a hermetically sealed, clean (no lubrication, no particulate & no polymer exposure), micron to 20+ psi pumping range.

- Basic Normetex Features:
  1. All stainless steel
  2. No polymers
  3. Hermetically sealed
  4. Completely dry – no lubrication within the hermetic seal
  5. No rubbing contact
  6. 30,000+ hours between maintenance
  7. Expensive – about $66,000 each
  8. Rebuilds – difficult with mixed success

NOTE: It may be possible to relax some of the polymer restriction.
Pump Considerations

- With Normetex obsolete, we need to evaluate our true process/safety constraints in the selection of an alternative. Issues to be considered when evaluating alternative pumps (note there are currently 59 Normetex pumps across Tritium Facilities that will need to be replaced over time):
  - Dry operation: what level of hydro-carbons (lube / methane) or Krytox could be tolerated in the process equipment or product (i.e., ppm, 0.1%, etc.)? Virtually none
  - Polymer exposure to process gas (tritium): how much can we live with? Which polymers cause more trouble? (SRNL continue to study polymer exposure) Some OK
  - Cost: how much is available to develop a replacement? Very Important – Find the money
  - Material: can we live with carbon steel or iron instead of stainless steel? Iron ??
  - Leak rate: what is really acceptable in our process? Hermetic seal 1e-7 cc/sec Helium
  - Particulate: is polymer particulate a concern? (11 micron filters before/after each pump)
  - Footprint not a problem
  - Piping configuration make pipe jumpers
Typical Scroll Pump Tip Seal

Varian pump with Viton O-ring & Polymer tip seal. Also note eccentric shafts with bearings inside the process gas boundary. This configuration is typical for vacuum scroll pumps.
Normetex Replacement Options (potential candidates)

1) Scroll Pumps
   1) Air Squared
   2) Edwards
   3) Varian/Agilent
   4) Busch
   5) Anest-iwata

2) Multi-stage Roots Pumps
   1) Pfeiffer
   2) Kashiyama
   3) Ebara

3) Piston – Metal Bellows
   1) Met-Bel (Senior Aerospace)
Options Considered

A: Use the closest existing pump on the market to a Normetex

B: Utilize a tip seal material minimally impacted by tritium

C: Utilize multi-stage roots pumps

D: Develop a non-lubricated hermetically sealed roots pump

E: Utilize Met-Bel pumps only in the process

F: Utilize a completely different style pump
SHORT TERM ACTIONS

SHORT TERM: A
BUY(3) EUMECA (NORMETEX) PUMPS
THIS IS MONEY THAT WAS ALREADY ALLOTTED
LONG LEAD TIME, PSD 9/13

SHORT TERM: B
BUY (5) OFF-THE-SHELF EDWARDS PUMPS FOR PURGE STRIPPER
REPLACE THE EXISTING NORMETEX SAVING THEM AS SPARES
CREATES (5) USED SPARES

SHORT TERM: C
SHUT DOWN (4) REDUNDANT PUMP TRAINS IN TEF
REMOVE THE NORMETEX PUMPS FROM TEF AS NEEDED FOR SPARES
CREATES (4) USED SPARES
MEDIUM & LONG TERM ACTIONS

**MEDIUM TERM**
- BUY (1) EDWARDS HERMETICALLY SEALED SCROLL PUMP
- TEST THE PUMP WITH & WITHOUT TIP SEALS
- REVERSE ENGINEER & TEST NEW TIP SEALS MADE OF VESPEL
  - VESPEL TIP SEALS MAY BE USABLE IN SOME PARTS OF THE PROCESS

**LONG TERM: A**
- USE THE EDWARDS PUMPS FROM THE MEDIUM TERM TESTING
- DEVELOP A NON-CONTACT METAL SEAL
  - PATH B
    - REVERSE ENGINEER & TEST NEW TIP SEALS MADE OF VESPEL
    - REPLACE VITON O-RING
    - PURCHASE NON-CONTACT PROTOTYPE PUMP FROM AIR SQUARED
    - THIS WOULD BE NEARLY DIRECT REPLACEMENT FOR NORMETEX
  - PATH C
    - DEVELOP NON-LUBRICATED PROTOTYPE PUMP WITH ROOTS VENDOR

**LONG TERM: B & C**
- DEVELOP NEW TRITIUM HIGH VACUUM PUMP SPEC
- PRESENT NEW SPEC TO ALL FOUR VENDORS
- PURCHASE NON-CONTACT PROTOTYPE PUMP FROM AIR SQUARED
  - ALL METAL, HERMETICALLY SEALED PUMP
Current Status
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• Eumeca reports progress. Assembly of pumps to begin in May with delivery on schedule in September.

• Bearing bronze flat wire to replace Edwards tip seal PSD 4/18/13.

• No manufacturer of a multi-stage roots blower pump was able to meet the technical challenges of converting their design.

• Air Squared of Colorado is positioned to produce a prototype pump for SRS that will be a very close substitute for the Normetex and will meet the technical requirements discussed.