U.S. DEPARTMENT OF ENERGY JSA

ITV Bellows RAR Summary

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Outline

- Downtimes
- Problem Description
- Cause
- Corrective Actions *(completed during 2015 SAD)*
- Pending Corrective Actions *(not yet assigned)*
- Summary

Bellows: Downtimes

- 5 separate downtimes for bellows failures.
  - 4 ITV bellows and 1 Faraday Cup 2 Bellows.
  - Total Downtimes:
    - ITV1L18/ ITV1L22: **33.16 hrs**
    - ITV1L10: **4.48 hrs**
    - ITV1L14: **2.45 hrs**
    - IFY0L03: **4.3 hrs**

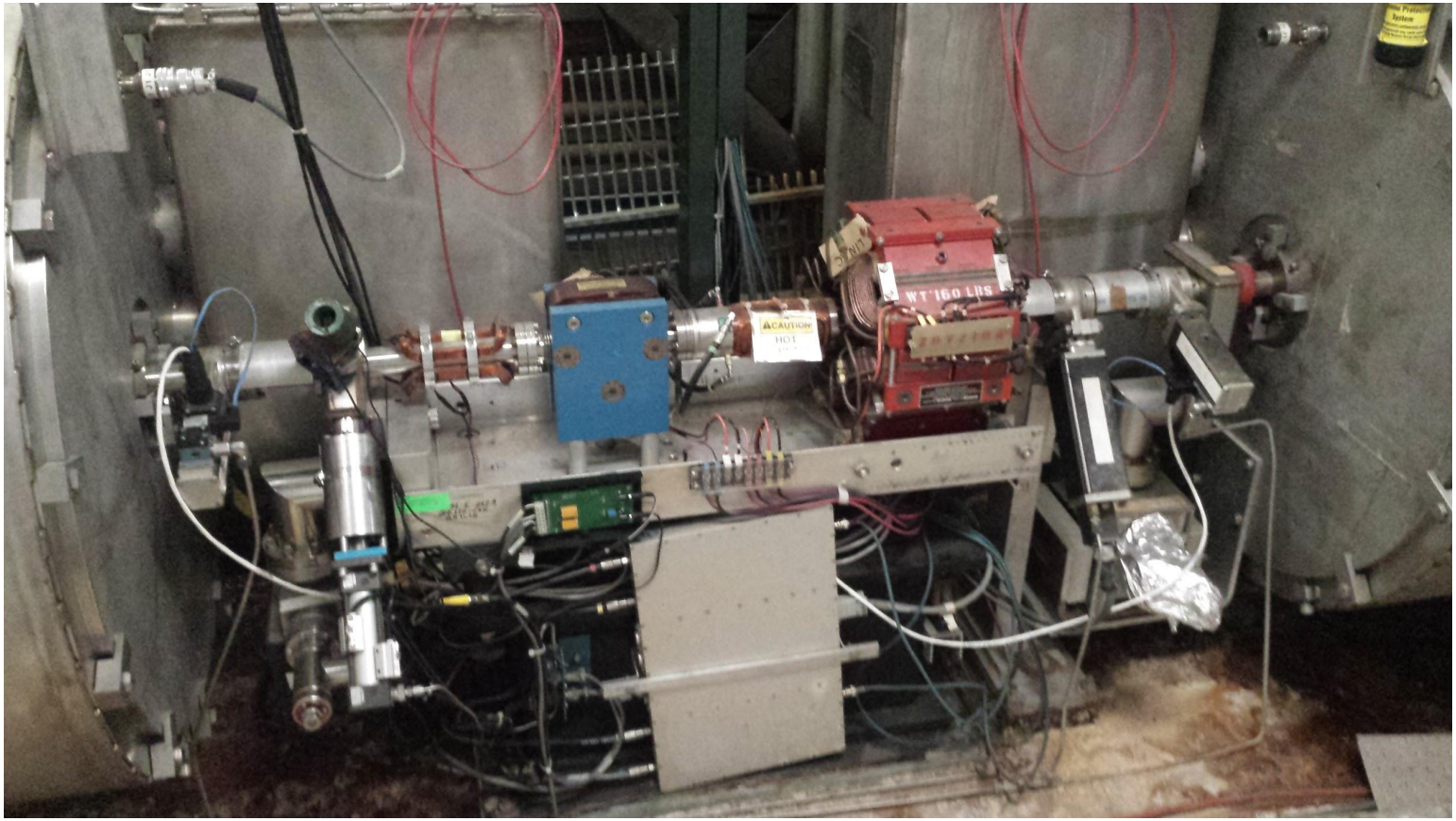
Bellows: Downtimes Cont.

- Original ITV1L18/ ITV1L22 events => **33.16 hrs** => Prompted **RAR** investigation.
- Additional failures occurred during investigation, broadening the scope of the report.
- Grand Total of Lost Time = **44.4 hrs**

Bellows: Problem Description

- Original Downtime on March 3, 2015 a pump cart was placed at 1L18.
- A few days later leak occurred again, this time ITV was suspected.
- VacSeal was applied to ITV1L18 bellows and then ITV1L22, and the viewers disabled in software.

Warm Region Girder



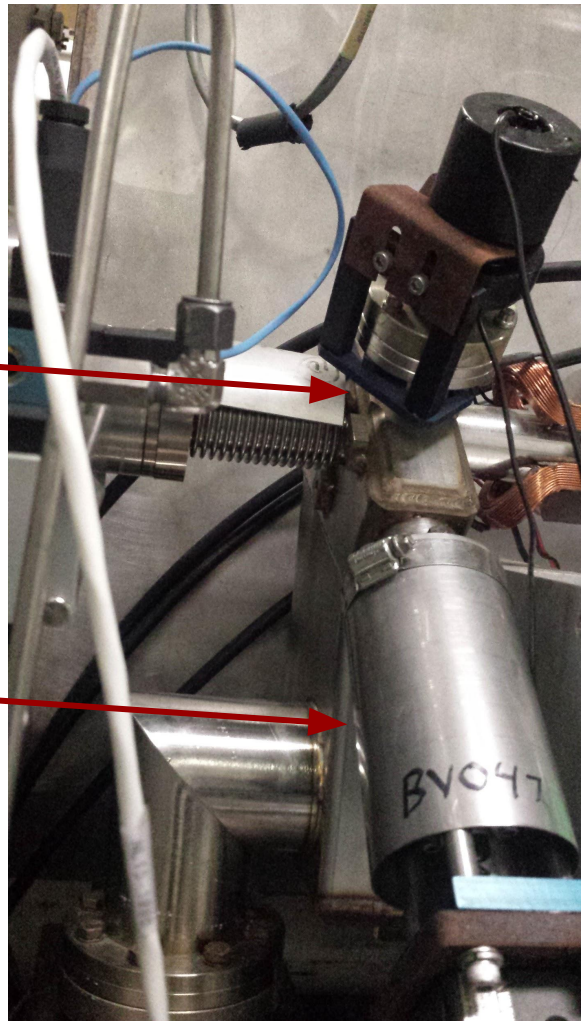
Problem Description Cont.

- In each of the Downtimes following, where ITV/ bellows was suspect they were sprayed with VacSeal
- Then disabled, by disconnecting power solenoid power.

Viewer Assembly

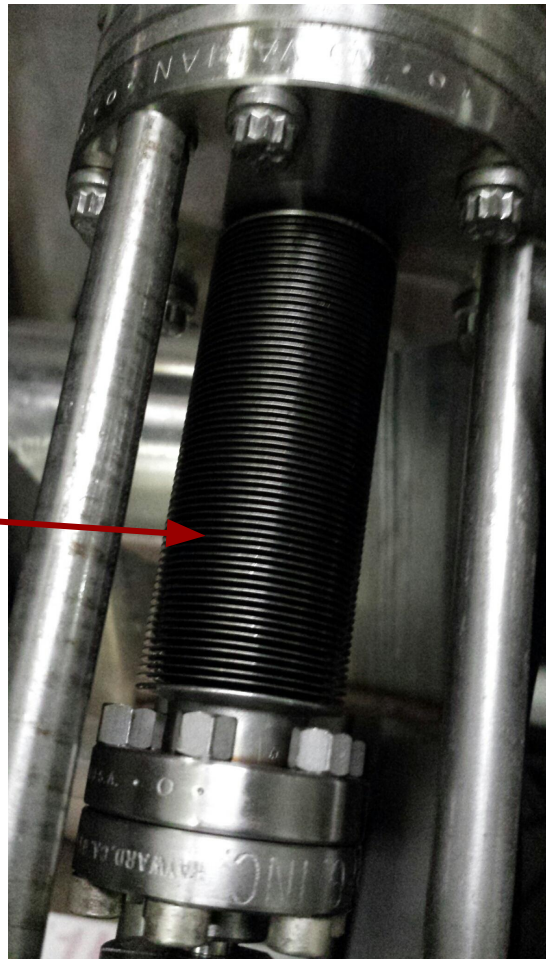
Standard Viewer Assembly on Warm Region Girder.

Bellows Housing, for insertable chromium oxide screen.



Viewer Assembly

Bellows with cover removed

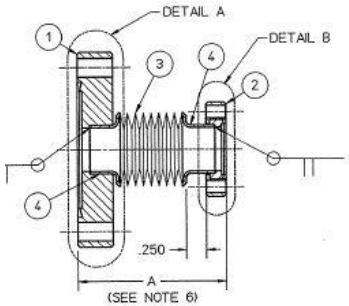


Bellows Profile

- From JLAB Drawing #58432-C-0100 Rev A.
- Standard Bellows PN# 103-55-5-EE:
  - Stanless Steel
  - 60 Convolutions
  - All individually welded.

NOTES: UNLESS OTHERWISE SPECIFIED

1. THE FOLLOWING C.E.B.A.F. SPECIFICATIONS APPLY BELLOWS SPECIFICATION FOR U.H.V. EQUIPTMENT: #11141-S-0105
2. NOM. BELLOWS O.D. 1.030
3. NOM. BELLOWS I.D. .550
4. PLATE THICKNESS .003
5. NO. OF CONVOLUTIONS 60
6. DIM. A: EXTENDED LENGTH 3.73
   COMPRESSED LENGTH 2.10
7. STROKE 1.625



SECTION A-A

For more information on Bellows Data:
See Standard Bellows Website www.std-bellows.com

Bellows: Cause

- Leaking ITV bellows, and FCup 2 bellows.
- This was confirmed during the first few weeks of the Summer 2015 SAD. Bellows were pulled and analyzed in the Vacuum lab.
- The cause was confirmed to be normal wear and aging bellows on ITV components.
- Manufacture of bellows, *Standard Bellows,* quotes a lifetime of 5000-10000 cycles at 1 ATM of differential pressure.

Bellows: Cause Cont.

- Team interviewed past and present operations staff to estimate the number of cycles, because this information is not archived.
  - The Linac Viewers were used very differently than they are now, and got heavy use during initial CEBAF commissioning.
  - Estimates showed that we are over 5000 insertions of the Linac viewers.

Corrective Actions Completed

- Team verified that JLab specifications for UHV bellows *(#11141S0105)* provided by Mechanical Engineering was indeed used in past and present orders.
- Team verified that the stroke lengths called out in drawings were not exceeding 75% of the extended length of the bellows, which is called out in the above specification.

Corrective Actions Completed Cont.

- During the first few weeks of the Summer down a change was made in the process in which the bellows are swapped out.
- The above procedural change and the low cost of the part allow us to be able to replace both North and South Linac ITV bellows, as well as the FCup 2 bellows.
- **ALL** should be in working condition for the upcoming run.

Corrective Actions Completed Cont.

- Insertion of the the viewers are now archived.
  - Method for counting cycles.
  - Replacement could happen prior to failure.
  - Can now better estimate lifetime of bellows for other ITVs as well *(Arcs, Spreaders, and Recombiners)*

Pending Corrective Actions

- It is recommended that someone from the Mechanical Engineering Group be assigned as the Design Authority for mechanical parts.
- Assessments should be done on other insertables to understand lifetime of bellows. *(Harps, Insertable Dumps, etc…)*

Pending Corrective Actions Cont.

- Better define Engineering response and Control Room protocol to keep Downtime as low as possible.
  - Parallel Troubleshooting
  - Control Room Training

Future Corrective Action

- If one of the newly replaced bellows happens to develop a leak, a detailed material analysis should be performed *(Metallurgy)*.

Bellows: Summary

- All Linac ITV Bellows replaced, along with FCup 2.
- Functionality of viewers and Faraday Cup have been restored.
- Ability to count cycles in the future.
  - For collecting quantitative data about number of cycles.
  - Possibility of preemptive replacement of bellows prior to failure.

For more information….

- See full report at:
  - http://opsweb.acc.jlab.org/CSUEApps/rerdb/?load=640
- Viewer Bellows Replacement ATLis:
  - http://devweb.acc.jlab.org/CSUEApps/atlis/task/15169