Gas turbine outage Sept 2012
Bad things happen to a well planned outage

1- Signed contract
2- All new parts ordered and received
3- All parts identified and on site
4- Scope of work complete for:
   Rotor life
   Internal alignment
   Gas turbine rotor work
   Generator work
5- Scheduled outage time 60 days
Gas turbine outage Sept 2012
Bad things happen to a well planned outage

Outage commences: ok
1- **Gas turbine rotor** – shipped to a different shop than original plan.
   Scope of work did not transfer to new shop
   People turnover- foreman changing weekly – no continuity
   16th stage wheel fit up to 17th stage
   Fork lift – ran into 17th stage compressor wheel
   Coating decision - wheels vs rotor (**5 day delay**)  
   New 2nd stage buckets would not balance (**5 day delay**)  
   New shop work schedule  2 x 10 vs 2 x 12 (**4 day delay**)  

2- Reports: - incoming and final
   Promised vs actual final report
3- Field work -Quality of millwrights : crushed liners (**4 day delay**)  
4- Rust in fuel line (**2 day delay**)  

Scheduled outage time 60 days **actual 80 days**
A - Know where your rotor is going:
   Does shop have the scope of work you provided?
   Documentation, incoming and final reports.
   Compressor wheel run outs:
   Review and sign off on inspection forms
   Stage 10 and 11 wheels patch ring repairs
   Rabbit fits: Male and female
   **Manufacturing fix’s to spec. Stage 16 and Stage 17 rabbit fits.**
   12 out of 17 wheels had a patch ring from day 1 that we did not know about

B - Compressor wheel rim gap:
   - R1-R2 … R15-R16  .006 to .024
   - R16-R17  .208-.216
New 16\textsuperscript{th} stage wheel
New 16th stage wheel
17th stage wheel
17th stage wheel
17th stage wheel end of life honing
Fork lift into 17th stage blades
Fork lift into 17th stage blades
Fork lift into 17th stage blades
Compressor blades

- 1- R1 – R4 trim angle 8 deg 48 min
- 2- R5- R17 str
Compressor rotor balance
Gas turbine outage Sept 2012
Bad things happen to a well planned outage

- What we found unit is running to the right rather center line
- Shrouds: diag clearance drawing 131E5655(105T0692)
- Opening S1 L side .209 R side .076 min spec (.104-.149)
  S2 L side .215 R side .125 min spec (.084 - .114)
  S3 L side .239 R side .088 min spec (.153-.132)
  New honey comb 3S clearance (.075-.123)
- Stage 1 shroud blocks thickness new 3.123” (radial)
  what came out .018 to .038” shorter. Closing clearance L .125 R .085

- Stage 2 shroud blocks thickness refurbished honey comb 1.799
  what came out .014 to .015” shorter Closing clearance L .093 R .095

- Stage 3 shroud blocks thickness new honey comb 1.799
  what came out old original design Closing clearance L .095 R .074

Turbine shell out of round: S1S .0166, S2S .0278 and S3S .0385
GE spec .010 or GE engr to bless
Flame scanner slot needs to be in the 7 o'clock not 5 o'clock
Can cover on
Collapsed Liner
Gas turbine outage

- Rotor life assessment
  - Aft Compressor wheel stages 13, 14, 15, 16, and 17
  - Compressor wheel # 16 retired.
- Distance piece
- Turbine aft shaft, stage 1, 2 and 3 turbine wheels
- Turbine: stage 1-2 spacer and stage 2-3 spacer
- Magnetic particle inspections.
- Hardness readings.
- Ultrasonic inspections
- No evidence of micro-cracks structure variations was documented
- No defects: run till 300 K hrs
Gas turbine outage

- Internal alignment: Laser GE drawing # 151D8742
- Unit running to the Right and up.
- 14 readings see
Gas turbine outage

Vertical Readings

As Found

10-Oct-12
Gas turbine outage

RECOMMENDATIONS

<table>
<thead>
<tr>
<th>FLANGE</th>
<th>VERTICAL MOVE</th>
<th>HORIZONTAL MOVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>INLET</td>
<td>DOWN .006&quot;</td>
<td>RIGHT .003&quot;</td>
</tr>
<tr>
<td>CDC FWD 11TH STG</td>
<td>UP .007&quot;</td>
<td>RIGHT .004&quot;</td>
</tr>
<tr>
<td>INNER BARREL</td>
<td>RABBIT FIT</td>
<td>RABBIT FIT</td>
</tr>
<tr>
<td>CDC AFT</td>
<td>LEFT .012&quot;</td>
<td>UP .003&quot;</td>
</tr>
<tr>
<td>SUPPORT RING</td>
<td>NONE</td>
<td>NONE</td>
</tr>
<tr>
<td>EXHAUST</td>
<td>LEFT .067&quot;</td>
<td>DOWN .004&quot;</td>
</tr>
</tbody>
</table>

NOTES: Above are the recommended moves to get the casings into GE specs. The bearings will be corrected after the casings moves are complete.
Inlet bell mouth after new coating
Gas turbine outage

- Coatings- Compressor wheels and inlet bell mouth
  1- D&L Quality Painting,
      12212 Green River Dr
      Houston TX 77044 office 281-458-3588
      Inlet Bell  mouth only
  2- Praxair co (SermeTel 5380 DP)
      Michael Romero 832-364-4988
      Inlet Bell  mouth , compressor wheels and abradable
  3- South West impreglon 281-441-2000
  4- B W Grind 713-641-0888
Forward flex seal mod 30 deg F cooler
Rust scale in Nat gas line

First blow 3x
Rust scale in Nat gas line

FIRST BLOW 3X
Gains after start up:

- CPD 20 psig higher (new compressor)
- Power: 6 MW
- New S1, S2 shrouds (.35 %)
- New S1, S2 and S3 buckets (.156 shorter)
- New S3 aero buckets, Nozzle and S3 honey comb shroud. GER 4217B (1.2%) + (.25%)
- What % of 6 MW is from the compressor vs turbine?

Approx 1 MW from closing gaps in turbine section and rest is due to new compressor
Gas turbine outage Sept 2012
Bad things happen to a well planned outage

- Unresolved items for future:
  - A - With in 1 year:
  - GE to share investigation results on S2 buckets
  - Replace liners-
  - New phase 5 package upgrade
  - B - Next Hot gas path? Or major
  - Huntsman to look at ? N2 pad on gas line
  - Huntsman to look at a new Gas conditioning system
  - Exhaust frame (#2 bearing) (major)
  - redo an internal alignment. (major)