Electric Power Systems inc.
Consulting Engineers

To:	Liam Carnahan, Dan Hines	**From:**	Jeff Rice
Fax/Email:		**Pages:**	2
Re:	GC Intake Troubleshoot	**Date:**	February 16, 2010

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- **Troubleshooting Results**

EPS was contacted by Liam Carnahan and Dan Hines of CBJ regarding problems with the operations at the Gold Creek Intake facility. Jeff Rice and Nick Yankee of EPS traveled to site to investigate the site infrastructure.

While on site the following problems were identified by Dan Hines:

- 10-31-2008: A power outage occurred. Both MDP breakers (pump distribution panel feeder breaker and building distribution panel feeder breaker) were found tripped. Well 3 building pump distribution panel's Well 3 breaker tripped.
- 6-1-2009: Fire in a Basin road home causes the utility to cut power. Several breakers tripped in well #2 and the main distribution pump feeder tripped.
- 3-12-2006: Fire downtown caused the utility to cut power. Generators were found running after power was restored. Both MDP breakers (pump distribution panel feeder breaker and building distribution panel feeder breaker) were found tripped.
- Other problems have been experienced with Well #2 control panel.
- It is believed that all pumps can attempt a start at once when the generator comes online.

CBJ's primary concern is that during outages the site remains operational and reliable.

After the site visit the Gold Creek facility was modeled in OTI's Electrical Transient Analysis Program (ETAP) ver. 7.1. The following was established from this analysis and on site observations:

1. Protective device coordination is poor at the upper levels. The Generator circuit breaker, Main distribution feeder to the Pump Distribution panel, and the Wells 3,4,5 panel breaker at the pump distribution panel all have breaker curves that overlap. The thermal magnetic trip ranges for these breakers cannot be adjusted sufficiently avoid this conflict. Therefore, it is indeterminate which of these breakers will open for overloads and/or faults, making it harder to establish where overloads and/or faults exist.
2. Pump starting demand for all pumps (as observed) is over 850A and can persist for several seconds. Several of the soft starters have current limiting settings that appear to

be rather high for their associate pump's starting torque requirement. Compare 100hp Well #3 pump's 100A starting current to 50hp Well#4 pump's 190A starting current.

3. Pump running real power demand is estimated at around 203kW, with Well #1 and Well#2 building power adding another estimated 6kVA. Starting power demand is over 600kW/800A and can persist for several seconds.

Conclusions/Recommendations

Overall the generation situation is marginal. The pump generator is rated at 250kW and is capable of carrying all observed loads at between 80-90% generator capacity. If the pumps themselves are fully loaded (mechanically) the generator can exceed 100% of the nameplate loading capability.

However, the critical problem is pump starting requirements. When the pump generator is online and multiple pumps are started at once, excessive power demands can cause voltage and frequency sags. This results in slower, longer pump starts with increased current requirements. At that point overloads and or breakers at several points in the system can overload (which protective devices operate is indeterminate due to poor coordination). A similar situation can occur if all pumps are running except for #2, #4 or #5 and the offline pump attempts a start.

EPS suggests taking these steps to increase site reliability in the short term:

1. Perform simulated outage / pump start tests on site to recreate problem with existing settings and get operational verification that simultaneous pump startups are the problem. Capture data with portable fault recorder in case further analysis is required later.
2. Implement new PLC logic to prevent simultaneous pump starts.
3. Examine and modify (if possible) settings on Well #2, #4 and #5 soft starts to reduce starting demand on the generator while providing sufficient pump starting torque.
4. Perform simulated outage / pump startup tests again to ensure issue is resolved.

Note that Well #2's control panel is reported to have some additional issues, which will require additional investigation if they are to be addressed. I believe that the Well #2 control problems are limited to Well #2 and can be addressed after the site wide power issues are resolved.

Long term options to increase site reliability include increasing the available generation and upsizing the feeder breakers. This would incur greater costs and is currently outside of the scope of this troubleshooting project. If desired, EPS can make further recommendations for this work.

Please contact me with any questions or concerns regarding this report.

Jeff Rice
Electric Power Systems, Inc.
907-789-2474 x5