

Fri 2/17/2006 10:09 AM

Doug

Attached is data from Ice Harbor. More to come...

Dan

Dan Ramirez, P.E.
Mechanical Engineer
Hydroelectric Design Center
503-808-4271

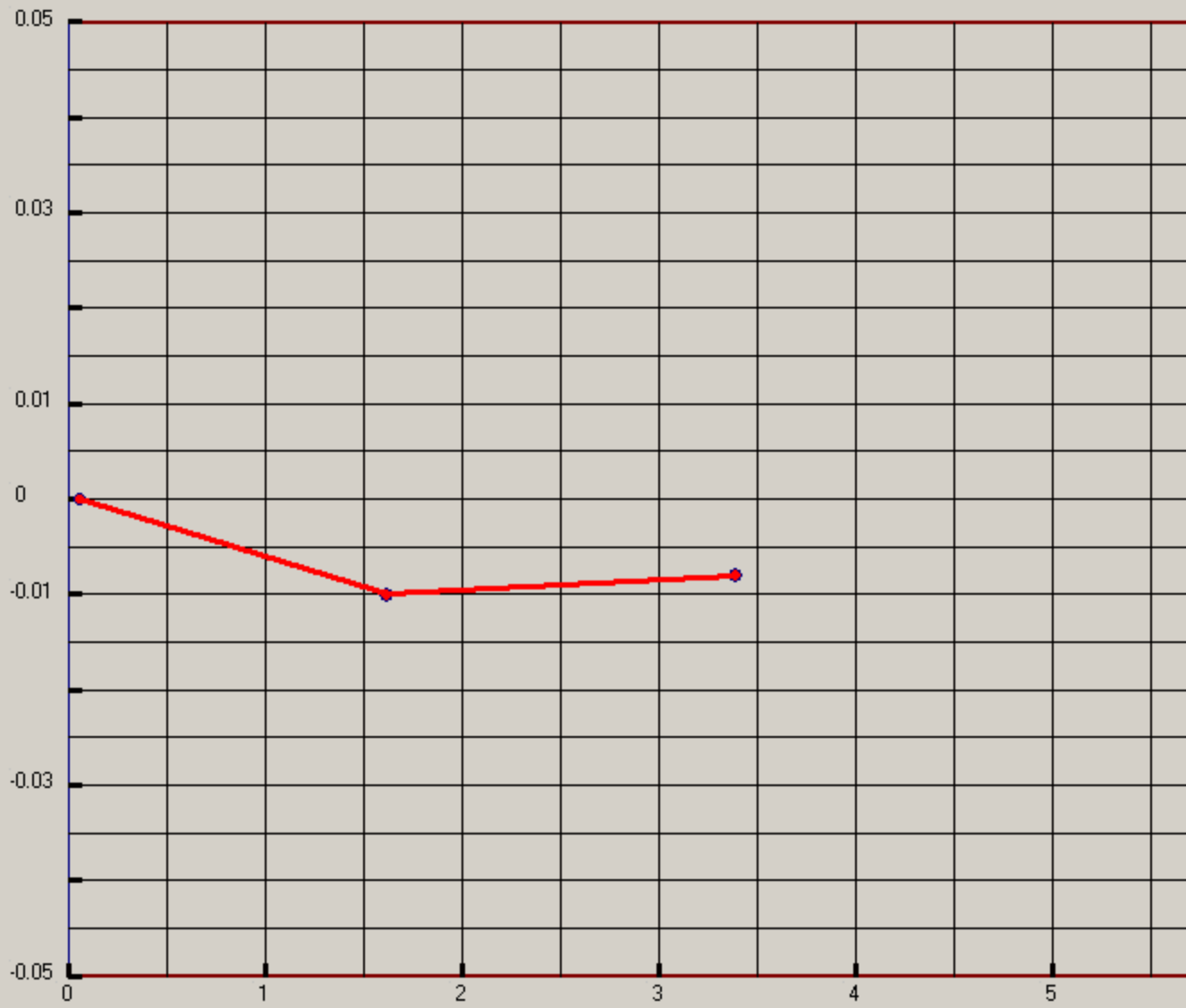
EU/V	EU
Pre Gain	Pre Bias
1.33277	-0.07064
Post Gain	Post Bias
0	1
Return to WKCals	

- C:\
- VB
- ITBRev1
- cals**
- BakUpLimits
- Cals-old 083005

Volts
3.3842

EU

CalError (Ft W.C.)



Volts DC from ATE-150 to LabPC-1200 A/D

Fri 2/17/2006 10:02 AM

[see attached](#)

Dan

From: DudleyDevices@aol.com [<mailto:DudleyDevices@aol.com>]

Sent: Monday, February 06, 2006 12:09 PM

To: Ramirez, Dan E NWP

Subject: plot

Dan,

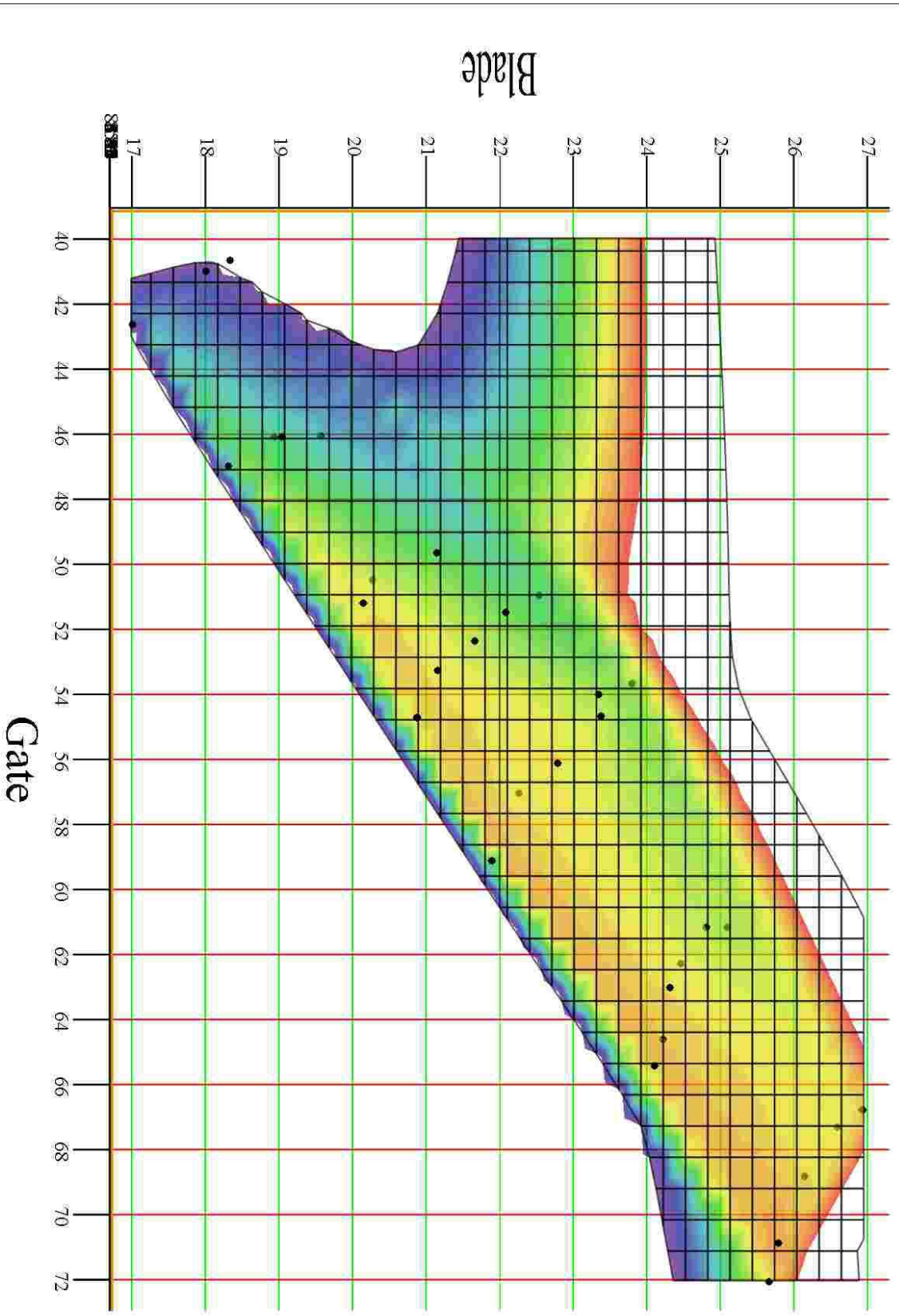
Would you please make a plot from this data set in your MathCad program like the one you made earlier?

This looks good as an underlay for displaying the data.

Your original plot was made before I got the calibration errors fixed. I'd like to see how the fix affected this plot when the points are projected on it by the PostProcessor as shown in the jpg.

Thanks,

Doug.



(Gate, Blade, Eff), (Gate, Blade, Eff)

Fri 2/17/2006 10:22 AM

Doug
All 3 days of data.
Dan

Dan Ramirez, P.E.
Mechanical Engineer
Hydroelectric Design Center
503-808-4271



IH U3 6 Feb 06.zip



IH U3 7 Feb 06.zip



IH U3 8 Feb 06.zip

Tue 2/21/2006 4:47 PM

Rod,

Ice Harbor Unit 3 test was conducted 6-8 Feb. IH Unit 6 testing was conducted 10-12 Feb. Both tests w/ screens installed. Test schedule for w/ screens testing tbd, but likely late-April or early May. Testing was conducted using traditional methods, i.e. initial on-cam pass followed by off-cam fixed blade angles at incremental gate openings (6 blade angles tested for Unit 3 , 7 blade angles for unit 6).

ITB was run in parallel with HDC data acq equipment for Unit 3 test only (using latest version of program --- ITB Rev 1 ver 43). ATEC provided W-K xducer and manifold was used in parallel to our Statham diff press transducer. (I had stopped by McNary and picked up x-ducer, buggy, crate and all). ITB installation and initial setup took longer than anticipated due to an old version of the interface between ITB and signal conditioner being used. Once the proper interface was located and installed, proceeded to calibrate W-K xducer without any difficulty. The previously observed computational problems and system crashes observed when balancing valve is opened have been corrected.

Attempted to use ITB during Unit 6 test also, but Murphy showed up and was unable to get W-K x-ducer output read into ITB. Attempts to isolate problem (i.e. to identify whether transducer/signal conditioner/ power supply within signal conditioner/interface between ITB and signal conditioner

or the cabling between each of these was the source of problem) to correct proved unsuccessful. Unfortunately, also could not figure how to feed 0.5-2.5 V output from our Statham (4-20 mA with 127 ohm scaling resistor) directly into ITB.

Unit 3 testing went very well. Repeatability was very good, on average +/- 0.1% or better in terms of relative efficiency, based on HDC data acq methods. Well defined blade angle profiles and overall unit performance profile obtained. Results indicate performance improvements on the order of 0.5% -1.0% obtainable. Tom Freeman on-site for Unit 3 test and reduced data near real-time (i.e. as near real-time as our acquisition methods allow). I established test points for 6-7 Feb testing. I pretty much let Tom run the show on 8 Feb. He did very well as Chief of Test for the day (conducting test, i.e. establishing gate blade positions to be tested, directing unit movements with operator/mechanic, data reduction). Tom also calibrated W-K x-ducers and results were superb --- we can discuss further, but suffice to say his eyeball is far more calibrated than mine.

For each test day, ITB was started-up at the beginning of each day and after limits defined, data collection initiated. ITB essentially ran in the background, collecting it's data, throughout each test day. No program crashes experienced on any test day. To obtain values from GDACS addresses, the ITB OPC was "connected" during testing, but blade perturbation routine was not initiated at any time.

During the first day of testing, the ITB logged data using "RECORD STEADY STATE" option, resulting in the same "rolling average" routine for data logging as before (McNary U9 test), i.e. large volumes of data being logged with each data point logged based on largely duplicated data. After discussing with Doug Albright the following morning, discovered I needed to toggle to the correct data logging option. As result of our McNary comments, "RECORD DATA POINT" option had been added and included in version 43. Data on 7 & 8 Feb was collected using "RECORD DATA POINT" option, reducing data set logged to discreet points as we had requested.

On return to office, I provided all raw data logged to Doug. In looking at the ITB data set here in the office (and discussing same with Doug) discovered the number of first and second pass points were left at default values. I should have increased 1st and 2nd pass points from default values of 5 points to 200 (forgot that this values were increased at McNary). If I had done so, each data point logged would have been representative of 2-3 minutes of steady state operation. With default settings, each point logged, although discreet, is representative of 5 seconds of steady state operation.

Attempted using MathCad for data analysis, using similar methods used to evaluate McNary ITB data set. However, due to 5 sec sampling, noise is too large and MathCad cannot interpolate 3-D contours. Have had better success using EXCEL to process Ice Harbor data, using more traditional 2-D methods. I've begun comparing results from data collected using our data acq to ITB data set and so far both are yielding the same results. Once completed, I can forward graphs showing results w/ comparisons, if you like.

As far as proof of concept, it's clear ITB is capable of collecting the data necessary to develop cam information. The major deficiencies identified from McNary test of ITB (system crashes and streamlining of data logged) have been addressed.

Regarding "ToDo List" generated from McNary testing (copy attached): Except for item's #1, #2, #10 and possibly #12, remaining items have been corrected.

Items #1 and #2 both require blade perturbation, the code for which was not installed in Ice Harbor Unit 2. Further, Item #1 was not critical to system functionality and Item#2 is a GDACS issue rather than an ITB issue.

Item #10 is in regards to the piping for existing W-K manifold being too large, permitting air into system. Existing manifold used as is with flushing methods modified to prevent air from entering. Large diameter hoses to turbine put were eliminated, short hose used to maintain water column/back pressure on downstream side of flushing valves, eliminating possibility of air entering system when flushing.

Item #12 is in regards to constants used to convert flow transducer voltage output to an engineering value (feet of deflection or cfs). These constants still revert to default values when system is shutdown. However, this may have been user error in that constants were never stored, which may have to be done manually, and then reloaded on start up. I need to clear this up with Doug.

More to come
Dan

From: Wittinger, Rodney J NWP
Sent: Sunday, February 19, 2006 11:54 AM
To: Ramirez, Dan E NWP; Freeman, Thomas A NWP
Subject: T1 test at Ice

Tom/Dan--please give myself, Ebner and Lee an update of what transpired during the testing. Rod

Dan---Please work with Lee to see if requirements are met and get back to me with findings. Thanks Rod

Von: DudleyDevices@aol.com [<mailto:DudleyDevices@aol.com>]
Gesendet: Mo 23.01.2006 08:47
An: Ebner, David A NWP
Cc: Wittinger, Rodney J NWP; Sheldon, Lee H NWP; Ramirez, Dan E NWP
Betreff: To Do list becomes a Been Done list

Dave,
You wanted a copy of the ToDo list with an explanation of what I did to fix all of them.
Here it is; does this satisfy the hurdles to get the retainage money?

The updated ITB Program will be on it's way to Dan shortly.
Best,

Dave, final entries in Green. All items on this list have been fixed, except for #s 1 & 2, which I cannot fix without you giving me the SoftPLC again, and telling Ed to remove the Zero Snatcher from the SoftPLC program.
Best, Doug. 06-01-22

INDEX TEST BOX MCNARY UNIT 9 PROOF OF CONCEPT TESTING

The following comments, suggestions or information are provided to document findings encountered by the HDC test team during the testing of Unit 9, the week of 11 – 16 Dec 2005. The contractor ATEC (Doug Albright and Greg Luna) were witness to and participated in the tests performed under W9127N-04-D-0009. The purpose of these field tests is to perform a “proof of concept” test of the device and software to establish if the “Best Effort” of ATEC met the minimum requirements of W9127N-04-D-0009.

The testing revealed and the contractor verbally agreed that many of the items listed would be corrected and a corrected software and hardware would be provided at no additional cost to the Government. If there are items that do not fall into the “no cost” category, Mr. Albright will let David Ebner know immediately. On this basis, ATEC shall correct all the numbered items below, unless otherwise noted. All of this stuff is done now.

The term “data collection” refers to the raw measurements and the calculation routine for logging ITB steady state measurements. The term “post processing” refers to process performed on the ITB steady state measurements to establish a steady state data set from which an “on cam” curve and the associated turbine performance curve are derived.

- 1 With perturbation initiated in the ITB, attempts to execute certain functions built into post processor cause program failure; namely functions which change displayed output graph scaling. This will be hard to diagnose without a SofPLC to work with. The perturbation function is specific to the OPC communication between the ITB and GDACS computers. I will work on this problem as data and equipment become available. 06-01-22 No change in my answer. I've tried this a few more times here with my ITB working in simulation. I see no evidence of any problem when the program is running with the OPC server connected to itself in simulation from rescaling data display graph by dragging and dropping the edge of the form to resize it. No trouble found.
- 2 This is a comment to ATEC seeking confirmation of the finding of the test team. The perturbation routine requires (1) a non-zero set point and alternating dummy signal (“-222”) be sent continuously to GDACS and (2) a logical value (1= perturbate on, 0= perturbate off) be sent to GDACS. This is correct. The nature of this communication was dictated by HDC and ACSI. Both signals must be recognized by GDACS for perturbation to occur. A blade perturbation set point of zero sent to GDACS eventually results in the logical value in GDACS being reset to 0, even though a logical value of 1 (sent as the Perturbation ON signal) has been sent by the ITB. Subsequent changes in set point to a nonzero value will not set logical to 1 in GDACS, and blade perturbation will not occur. This will cause problems when ITB is in “AUTO” mode.

The Perturbation function became a great point of contention between HDC, ACSI and Actuation Test Equipment that has not been resolved to any satisfaction.

Here's how it works:

The GDACS interface requires two inputs from ITB to engage the Perturbation function.

- 1.) The Perturbation On/Off bit in the SoftPLC is set to a 1

2.) The SetPoint value must be set to a non-zero value.

The SoftPLC 3-D cam has a Watchdog function that monitors the SetPoint output of the ITB. If there is not a new SetPoint value transmitted by the ITB to the SoftPLC at least every 10 seconds, the WatchDog will disengage the Perturbation function.

Whenever the SoftPLC reads a valid SetPoint value from the designated input register, the SoftPLC reads it in, adds it to the Ideal Blade value, and then writes a dummy value (-222) back into that register. This new "Perturbed" value becomes the SetPoint for the blade controller.

Every time the SoftPLC executes its Relay Ladder Logic code (approximately once every 130 milliseconds) it looks at this register again to check for a new valid SetPoint value.

If the value in the register is still -222, the WatchDog timer is updated to add the elapsed time since the last read.

The ITB to SoftPLC communication uses the industry standard OPC protocol, which is a "change-oriented" methodology. In short, if the value to be transmitted over the OPC link has not changed since the last time a value was sent, in the interest of reducing network traffic the new SetPoint is not sent. For this reason, if the SetPoint has not changed, the ITB will not send the value to the SoftPLC, because the OPC server knows the SoftPLC already has this value in it.

To keep feeding the SoftPLC WatchDog and prevent it from timing out, the ITB sends a dummy value (-222) to the SoftPLC alternating with the SetPoint every 5 seconds, this allows it to maintain the transmission interval and prevent the WatchDog from timing out.

This system works well, unless the SetPoint value from the ITB is a zero. This is where the problem comes in. The following narrative describes the events surrounding this problem.

If you don't like the fact that the SetPoint cannot be a zero, take it up with Ed.

06-01-22 No change in my position on this one. Take the presence of the Zero Snatcher in the SoftPLC up with Ed.

3 In general, the user interface and plotting routine information as presented on screen is difficult to sort out to initial user. Sizing window for plotting is cumbersome, and re-scaling can cause program to crash. Presenting blade, power, flow, and efficiency against gate on same plot can make plot difficult to decipher.

The PostProcessor has been modified to add selector buttons to turn the Blade, Flow, Power and Efficiency trances on and off individually. As time allows and operator feedback comes in, this will be improved to make it just like you want it.

I've changed the type of the small display windows so they can be resized.

Both steady state and "near real-time" values for each are plotted, as well as a history, which over substantial length of time makes plot virtually unreadable. Suggested streamlining information presented, and presenting only a limited history trace. A new logic pattern sets up the method that collects data until the number of averages selected has been collected. This is where it can record a point if all of the SteadyState limits are met. Whenever a point is recorded by this new method, the graph is updated at the same time.

- 4 Manually adjusting individual limits (e.g. limits for first and second pass standard deviations, outliers, and rate of change/slope) is not possible when in "Index Test" and/or "OPC connected" mode. Adjusting limits using the "AUTOLIMITS" option works, however all limits are scanned and adjusted accordingly, which can be problematic. For example, if user desires to expand limits on forebay elevation and hits "AutoLimit" to adjust, before limit adjustments are complete, another variable may exceed limits and "AutoLimit" will then try to expand limits for this second variable, which may not have been desirable. Suggest allowing individual adjustment of limits when using "AUTOLIMITS".

Done, Each of the measured parameters are individually AutoLimits adjustable now. To use individual AutoLimit, click on the data value flag on the SteadyState form.

- 5 After check calibrating the W-K TD, we had some difficulty with the ITB calibration routine-- with balancing valve opened, a calculated negative value results which bombed the ITB program. Please correct. No bombing allowed.

This has been fixed. Software bug was fixed.

- 6 While making an editorial correction, we changed identifier in "SECURITY" window from "Unit 5" to "Unit 9". Doing so unregistered the program requiring "backdoor" password to resolve. We also noticed the limits for defining steady state had been reset to minimum levels. Previously stored limits were not recoverable using "LOAD LIMITS" function.

This has been fixed. Load Limits feature was modified to correct his.

- 7 There were numerous ITB program bombs, (Tsk, tsk. Bombing again!) which were unexplained, but it appeared that buffer file(s) somewhere fill up and program stopped. Failures were intermittent in nature, did not appear to be related to length of time program was running. A relaunch of program following failure causes the overwriting of some of the stored data (notably "5K average" file, which is log of all data initiated when "RECORD ALL" option is toggled).

I believe the crashing has been fixed, and the overwrite problem was fixed. This is fixed.

- 8 Headers at the top of each steady state data file overwrite the first six lines of logged data.

The headers don't overwrite the data, but the data counter does count the header lines in addition to new data. Done. Reconciled the data array pointers to each other.

- 9 During testing, a setting of 200 second pass scans was used, meaning second pass averages are based on 200 data scans collected, requiring roughly 280 seconds of elapsed time to collect. A "rolling" average is used, based on the most recent 200 scans collected. This can result in consecutive steady data points being logged which are based on 199 of 200 scans having duplicated data and a tremendous amount of data being logged. It is recommended that once a data point is logged, the buffer be reset to establish 200 unique scans that meet steady state criteria doing so each data element logged will represent 200 distinct points.

Sure, no problem. The program has a feature where it won't save a data point to disk until 200th point is taken, and then it will save one average and erase the lot. This will be an optional collection mode in addition to how it works now. Done.

10 During a recalibration check of the W-K transducer, air had entered the system during the flushing operation. The drain/flushing valves are too large in diameter for calibration adjustments by bleeding to be made.

A new manifold has been constructed that has smaller valves, and small bleeders on every valve. Let's haggle about how to get it into your hands... I have two more manifolds on test carts. One is done, the second is under construction.

11 There were some problems with starting up the ITB program with values not being read into headers. It appeared that there was some difficulty with the initial buffer filling and simultaneously turning on the OPC prior to the buffers filling with information. This is provided as information to ATEC for resolution.

This problem has been fixed.

12 On restart of the ITB program, it appears default values are re-established in some cases and comparisons of resulting calculations before and after system crash/restart may be misleading. For example, flow calculation appears to default to without screen parameters on restart. If with screen parameters were used prior to system crash making direct comparisons of recorded data invalid. Suggest a warning be provided to the user on any restart of the program that default values are now being used.

This problem has been fixed.

13 "Post-processing" is limited to presenting logged data

The PostProcessing function is available to work on the data files after they are recorded. The live display uses the PostProcessor utilities for on-line analysis and display of the test results. As it is now, the ITB paints the data on the monitor while the program runs.

14 "Post processing" data analysis should be performed starting with raw data. Logged flow results are based on user defined flow coefficient and exponent, which due to system crashes were not consistently applied over several days of testing. Similarly, adjusted power and flow results are based on single user defined head. Over extended unattended operation, head variations may be excessive, requiring data to be separated and normalized to several heads. Logged values for ITB calculated efficiency is in error, appears conversion from kW to hp was not performed in calculation.

This problem has been fixed. The PostProcessor loads up the field test data files. The calculated values of inches W.C., Ft W.C. flow, corrected flow, corrected power and efficiency are all discarded from the field test data files. When these files, or anyother .prn file of this format, these values are all recomputed using operator input values during PostProcessing.

15 All "data collection" (raw data) should be logged to maximum of 6 significant figures. Data logged from GDACS/3D cam for gate, blade, head and flow volts are truncated to 4 significant figures. Unclear if data as received from 3D cam is truncated or if truncation or rounding is part of ITB data logging. Any rounding should occur after calculations are performed. And only by authorized rounding personnel.

Data logged is 5 significant figures. Output was rounded to 4 places in a few places. Authorized rounding personnel? How much does this job pay? This has been set to 5 significant figures everywhere. The 4-Place rounding was in the PostProcessor output and has been fixed.

With the lessons learned from this Field Test, I have been, and will continue to make many improvements to the ITB program function and operator interface. I welcome all comments

and suggestions and will continue to send updates as they become available, as long as I still have this identical computer here. I need to know exactly what the program is doing in your computer by working on it in my identical computer here.
All of the items on this list, with the exception of #s 1 & 2, have been fixed.

Best,
Doug

Fri 2/24/2006 11:21 AM

Dan--Nice summary and thanks. Lee do you agree? Regards Rod

Von: Ramirez, Dan E NWP

Gesendet: Fr 24.02.2006 11:13

An: Ebner, David A NWP; Todd, Wayne A NWP

Cc: Wittinger, Rodney J NWP; Sheldon, Lee H NWP

Betreff: RE: Initiate ITB final payment on LI 0001. We keep the retainage for now.

Dave,

RE: Step-by-step and documentation notebook, which combined are the closest we have to a "User Manual". For someone familiar with system components and software, these items provide most of the information needed to get ITB up and running. One of the most glaring deficiencies is a clear description of the latest cabling and interface required between W-K xducer and the ITB. The step-by-step does not address the ATEC-150 signal conditioner and the dongle between ATEC-150 and ITB at all. The documentation notebook has earlier designs for cabling, ATEC-150, and dongle, and does not clearly identify latest components. This is problematic in that the earlier designs are not interchangeable.

Format of step-by-step could be improved by breaking into sections, e.g. "Installing W-K Transducer", "Connecting W-K Transducer to ITB", "Calibrating W-K transducer", "Setting Steady State Criteria using AutoLimits", etc. The documentation notebook is very poorly organized. Major revisions, re-organization and elimination of outdated materials is required for it to be of use.

Nonetheless I'd recommend accepting user manual as is. As with any system, as the user becomes familiar with the components and software, the need for a user manual lessened. It is expected that the effort required to develop a user manual that an initial user would find of use would be significant. Such an effort exceeds the need.

RE: Final Report. Evaluation was limited to data collected when unit was in "Local" control, i.e. no evaluation of data collected in Automatic Generation Control is presented. We eventually hope to run the ITB an unattended mode, where the unit will be operated exclusively in AGC. As such evaluation of AGC data collected at McNary is most pertinent.

Doug's approach to data reduction appears to require review of each data file logged to make a judgment if information is suitable for use in further analysis. Over 2 days of blocked unit testing,

my recollection is that there were over 700 data files logged. Such an approach is tedious. Using this approach, Doug came up with a reduced data set of 61 files.

Doug's conclusions are essentially the same as my independent review of same data using other analysis methods. The collected data demonstrates the ITB is capable of monitoring unit operation and determining when user defined criteria for steady-state is met. Once met, the ITB begins to log data at user definable intervals. Updated cam information can be developed from steady state data collected. Further, unit operation during data collection, i.e. automatic generation control or local unit control, yields similar cam results.

I'd recommend accepting final report as is.

Dan

From: Ebner, David A NWP
Sent: Tuesday, February 21, 2006 5:25 PM
To: Todd, Wayne A NWP
Cc: Wittinger, Rodney J NWP; Sheldon, Lee H NWP; Ramirez, Dan E NWP
Subject: Initiate ITB final payment on LI 0001. We keep the retainage for now.

Wayne,

It is my understanding we have now accepted #2, Post-processing, #3, analysis, #4, Odds & Ends List. Remaining are the Manual and the Final Report. On the one hand, I know the guys are very busy with other projects, and have, like me, spent way too much time on this one, on the other hand, we've passed two deadlines for notifying me that we've accepted everything. We cannot go on forever not paying ATEC their money, once they finally submitted a correct invoice.

Request you initiate payment of the remaining amount on Line Item 0001 on this contract. You may wish to request a new invoice from Mr. Albright in the final amount.

Retainage will continue to be withheld until the modification for swapping the equipment for 18 mos. warranty, and setting new unit prices is done.

FYI: Ralph has seen fit to pull my contracting officer authority from me because he knows I am initiating an action against him for his bad boy behavior. He says I am a bad person, who no longer knows how to run a contract or make a timely award. Sour grapes. But I can't sign anything, or approve anything.

David Ebner, A/E Contracts
Army Corps of Engineers, Portland, OR
(503) 808-4611, fax-4605
David.A.Ebner@nwp01.usace.army.mil
"The Best Information Leads to Success"

Wed 3/1/2006 9:04 AM

Dan, I am available at either time. Rod

From: Ramirez, Dan E NWP
Sent: Tuesday, February 28, 2006 3:27 PM
To: Allison,Jack - PGF; Smith, David B NWP; Nelson, Richard E NWP; Miska, Edward P NWP; Sauve, Gerald L NWW; Sheldon, Lee H NWP; Wittinger, Rodney J NWP
Subject: RE: draft action items from 1/25/06 HOT meeting

Gentlemen,

Action Item from last HOT meeting was to have sub-group meet to address future work for T1. I intend to provide an update on ITB status (incl. recently conducted Ice Harbor testing).

Goal is to reach consensus for T1 course of action. Options to discuss:

- continue with proposed ITB Phase 2 (demonstration project, multiple units same family, Kaplan & Francis)
- propagate ITB
- development of T1 code in GDACS
- consider other options, combinations of above

I delayed scheduling meeting until Rod's return from McNary model testing, but did not realize Rod was heading back out next week for additional testing.

Please let me know your availability this Friday, 3 March, for meeting @ 1000 or 1300. Depending on availability, I'll arrange room.

Dan

SUBJECT AREA	ACTION	RESPONSIBILITY	DATE INITIATED	DUE DATE	STATUS
Type 1 optimization	Establish small team to determine future TI work	Ramirez	1/25/06	3/1/06	Tea Def dat

From: Foulkes,Gabrielle F - PGF [<mailto:gffoulkes@bpa.gov>]
Sent: Tuesday, February 07, 2006 11:10 AM
To: Allison,Jack - PGF; Beale,Katherine L - PTT; Mike Berger; Tanovan, Bolyvong S NWD; Miller, Brian D NWW; Moentenich, Brian L NWP; Knaak, Carl R NWW; Fouts, Clayton A NWP; Ramirez, Dan E NWP; Watson, Daniel M NWP; Smith, David B NWP; Davis,Steven T - PGSD; Nelson, Richard E NWP; Dies,Robert W - PGF; Faulkner, Donald L NWD; Kwong, Duncan NWP; Miska, Edward P NWP; Hicks, Gail S NWW; Smith, Glen A NWP; Kathy Hacker; Halpin,Francis J - PGS; Sedgwick, Jeffrey M NWW; Sauve, Gerald L NWW; Summers, Joseph L NWS; Johnson,Kevin M - PGSD; Jones,Mark A - PGF; Earlywine, Kenneth G NWP; Haas, Larry H NWP; Sheldon, Lee H NWP; Mendiola, Marty T NWW; Colesar, Mike S NWP; Murphy,Thomas R - PGF; Ryan, Randall B NWW; Vaughn, Rich A NWP; Hammer, Richard A NWW; Werner, Richard D NWS; Emmert, Rick L NWW; Ford, Robert W NWP; vanderBorg, Robert D NWP;

Wittinger, Rodney J NWP; Robson, Ron C NWW; Bennett, Daniel S NWS; Fu, Showin M NWP; Perkins, Stephen R NWP; Chen, Su-Chen NWS; Tauber, Lou A - PGF; Thor, Phil - PGF; Glover, Thomas W NWW; Ferris, Wanda L NWP; Todd, Wayne A NWP

Subject: draft action items from 1/25/06 HOT meeting

Attached is a draft of the action items from the last meeting of the Hydro Optimization Team, held on 1/25/06. Please let me know if you have updates or questions.

<<ActionItems-HOT-Corps.xls>>

The next meeting of the Corps HOT is scheduled for May 23-24 in Seattle, timed to precede the capital workgroup, which is scheduled for May 24-25 in Seattle. Details will be worked out as we get closer to the date.

[gabrielle, 503-230-4217](mailto:gabrielle@corps.gov)