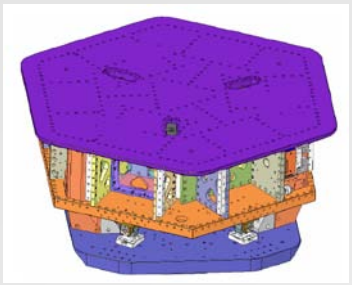
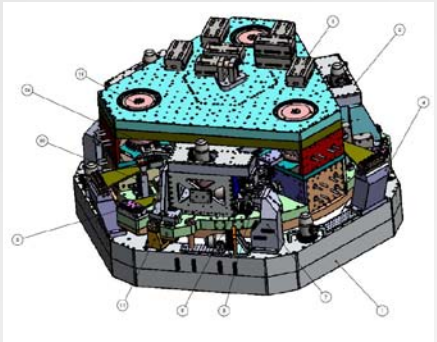
G1100169 - Seismic Testing and Commissioning Overview

Seismic Modules



15 HAM-ISI



15 BSC-ISI

15 HAM- HEPI
&
15 BSC-HEPI

Seismic Testing and Commissioning Team

@ LHO
Corey Gray
Eric Allwine
Jeff Garcia
Hugh Radkins
Vincent Lhuillier

@ LLO
Adrien LeRoux
Céline Ramet
Mike Vargas

@ Stanford
Brian Lantz

@ MIT
Jeff Kissel
Fabrice Matichard
Richard Mittleman
Sébastien Biscans

1) DCC Documentation

E1000304
aLIGO SEI Testing and Commissioning Documentation

Abstract:
This page contains the links to the Seismic Group testing and commissioning documentation of the Advanced LIGO SEI installation.

Per M1000211 Testing requirement, it contains:

1) Device Level Testing:
- Electromagnetic Actuators: T0900564-v2
- Trillium
- GS13

Data for the GS13 testing after modification are in the SVN at: SeismicSVN\seismic\Common\Data\aLIGO_GS13_TestData\PostMod_TestResults_PDFs.
Instruments location is summarized in: E1000058
- L4C
- CPS

2) Module Testing

3) Sub-Assembly Level Testing
- Trillium Pod Assembly
- GS13 Pod Assembly
- L4C Pod Assembly

4) Major assembly level testing:
- aLIGO HAM-ISI Testing and Commissioning Documentation
- aLIGO BSC-ISI Testing and Commissioning Documentation
- aLIGO HAM-HEPI Testing and Commissioning Documentation
- aLIGO BSC-HEPI Testing and Commissioning Documentation

Related Documents:

- LIGO-E1000305: aLIGO HAM-ISI Testing and Commissioning Documentation
- LIGO-E1000306: aLIGO BSC-ISI Testing and Commissioning Documentation

LIGO Document E1000305-x0

aLIGO HAM-ISI Testing and Commissioning Documentation

(QA: **Uncertified**)

Abstract:

The documentation include:

1) HAM-ISI, Pre-integration Testing, Phase I (post-assembly, before storage)

Procedure:
- E1000309, aLIGO HAM-ISI, Pre-integration Testing Procedure, Phase I (post-assembly, before storage)

Tests reports for the tests stands used to do the Pre-Integration testing:
- E1000341, HAM-ISI LHO test stand: software, electronic checks, and user guide
- E1000300, HAM-ISI LLO test stand: software, electronic checks, and user guide

Tests reports and results for each unit, including the data (one test report per HAM-ISI):
- E1000310, aLIGO HAM-ISI, Pre-integration Test Report, Phase I, LHO Unit #1. (Testing done, documentation in progress)
- E1000311, aLIGO HAM-ISI, Pre-integration Test Report, Phase I, LHO Unit #2. (Testing in progress)
- E1000312, aLIGO HAM-ISI, Pre-integration Test Report, Phase I, LHO Unit #3. (Upcoming)
- E1000313, aLIGO HAM-ISI, Pre-integration Test Report, Phase I, LHO Unit #4. (Upcoming)
- E1000314, aLIGO HAM-ISI, Pre-integration Test Report, Phase I, LHO Unit #5. (Upcoming)
- E1000323, aLIGO HAM-ISI, Pre-integration Test Report, Phase I, LHO Unit #6. (Upcoming)
- E1000324, aLIGO HAM-ISI, Pre-integration Test Report, Phase I, LHO Unit #7. (Upcoming)

- E1000325, aLIGO HAM-ISI, Pre-integration Test Report, Phase I, LLO Unit #1. (Testing done, documentation in progress)
- E1000326, aLIGO HAM-ISI, Pre-integration Test Report, Phase I, LLO Unit #2. (Upcoming)
- E1000327, aLIGO HAM-ISI, Pre-integration Test Report, Phase I, LLO Unit #3. (Upcoming)
- E1000328, aLIGO HAM-ISI, Pre-integration Test Report, Phase I, LLO Unit #4. (Upcoming)
- E1000329, aLIGO HAM-ISI, Pre-integration Test Report, Phase I, LLO Unit #5. (Upcoming)
- E1000330, aLIGO HAM-ISI, Pre-integration Test Report, Phase I, LLO Unit #6. (Upcoming)
- E1000331, aLIGO HAM-ISI, Pre-integration Test Report, Phase I, LLO Unit #7. (Upcoming)

2) HAM-ISI, Pre-integration Testing, Phase II : Final tests done after storage and before insertion (This phase has not started yet).

3) HAM-ISI, Integration Phase Testing: Procedure and results related to the commissioning in the chamber (This phase has not started yet).

E1000341
HAM-ISI LHO test stand: software, electronic checks, and user guide

LIGO

LIGO- E1000341

- *Step 3 - Software check*

For Detailed info on all software, please see Appendices 4 & 5.

- **ssh Connection From A Workstation To The Front End (i.e. Test Stand Computer)**

(Obsolete Test)

The test stand computer configuration is described in appendix 4. An ssh (secure shell) connection is necessary to access and work on the Front End computer.

To test the connection, open a terminal on a workstation and connect using the command:

> *ssh -X controls@stormy.ligo-wa.caltech.edu*
Password: contact Corey Gray

→ **ssh connection test:** **Passed: ___** **Failed: ___**

Check List:

SSH Connection
SVN
MEDM
Dataviewer
Awgstream
DTT
Foton
Matlab
mDV and ligodv
ini file
Data acquisition package

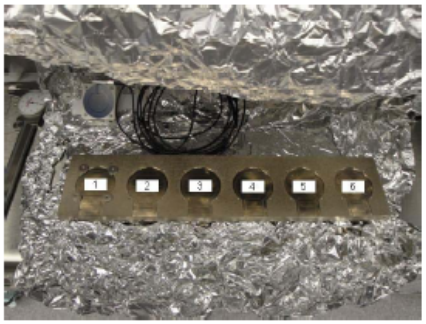
E1000309
aLIGO HAM-ISI, Pre-integration Testing Procedure, Phase I (post-assembly, before storage)

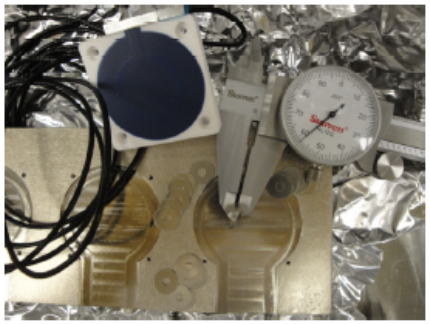
LIGO-E1000309

I. Pre-Assembly Testing

- *Step 1: Position Sensors*

Set up the offset on the jig. The test jig is shown on the picture below. Shim washers are used to set up the gap between the position sensor and the jig. A caliper is used to measure the jig cutout depth and the shims thickness.





6 shims are measured at 0.058". The cutout in the jig is 0.030" deep. The sensor extends out approximately 0.007" away from the surface where the shims are placed. So the gap is set up to be 0.081" nominal.

Acceptance Criteria:

[redacted]

LIGO

LIGO-E1000309

II. Tests to be performed during assembly

- *Step 2: Check gaps under Support Posts*

Procedure to follow for this test:
Try to push a 0.001 inch shim between the Support Post, Gussets and Stage 0 along the edges shown below.

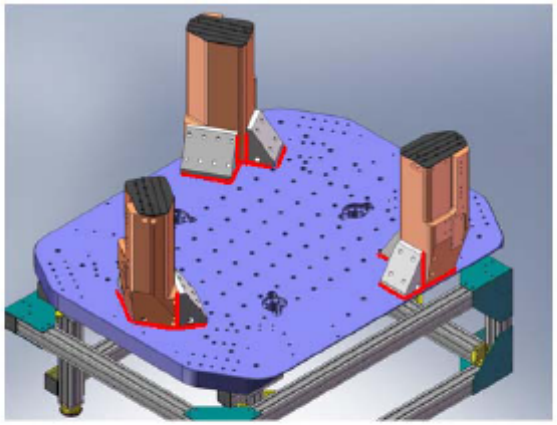


Figure - Showing edges that need checked on support posts and gussets

[redacted]

III. Tests to be performed after assembly

This section describes the tests performed to check and validate the subassemblies and overall assembly good functioning. From step 8, data collected, Matlab scripts and figures, documentation have to be posted on the local copy of the SVN. Appendix 4 describe the path used to store data. X1 and X2 are respectively the Hanford and the Livingston test stand. In this procedure document, an example is given for the test realized on HAM-ISI-LLO-unit1. SVN information that refer to sites, units and dates are colored in red (Scripts, data and figures names). Black is used for generic name.

- ***Step 1 - Actuators Inventory***

Write down the actuators serial number in the table below.

Actuator	Actuator S/N
H1	
H2	
H3	
V1	
V2	
V3	

Table - Actuators' inventory

Acceptance Criteria

- Inventory is complete

III. Tests to be performed after assembly 16
- Step 1 - Actuators Inventory 16
- Step 2 - Sensors Inventory 16
- Step 3 - Electronics Inventory 17
- Step 4 - Set up sensors gap 18
- Step 5 - Measure the Sensor gap 19
- Step 6 - Check Sensor gaps after the platform release 20
- Step 7 - Check range of motion (hand pushing) 21
  - Step 7.1 – Test N°1 21
  - Step 7.2 – Test N°2 22
- Step 8 - Capacitive position sensor Power Spectrum 23
- Step 9 - GS13 power spectrum 25
  - Step 9.1 – Table locked and unlocked (free) 25
  - Step 9.2 – Table tilted 25
- Step 10 - Coil Driver, cabling and resistance check 28
- Step 11 - Actuators Sign and range of motion (Local drive) 30
  - Step 11.1 - Actuators sign 30
  - Step 11.2 - Range of motion - Local drive 31
- Step 12 - Vertical Sensor Calibration 32
- Step 13 - Vertical Spring Constant 34
- Step 14 - Static Testing (Tests in the local basis) 35

E1000311
aLIGO HAM-ISI, Pre-integration Test Report, Phase I, LHO Unit #2

- *Step 18.2 - Cartesian to Cartesian - Comparison with HAM6*

Scripts files for processing and plotting in SVN at:
opt/svncommon/seisvn/seismic/HAM-ISI/X1/Data/Unit_2/Transfer_functions/Cartesian_to_cartesian

- Plot_TF_Cartesian_to_Cartesian_2010_08_28.m

Cartesian to Cartesian figures in SVN at :
/svncommon/seisvn/seismic/HAM-ISI/X1/Data/Unit_2/Transfer_functions/Cartesian_to_Cartesian

- TF_X_Y_RZ_CPS_vs_HAM6.fig
- TF_Z_RX_RY_CPS_vs_HAM6.fig
- TF_X_Y_RZ_Geophone_vs_HAM6.fig
- TF_Z_RX_RY_Geophone_vs_HAM6.fig

GS13, Cartesian to Cartesian measurement, Undamped

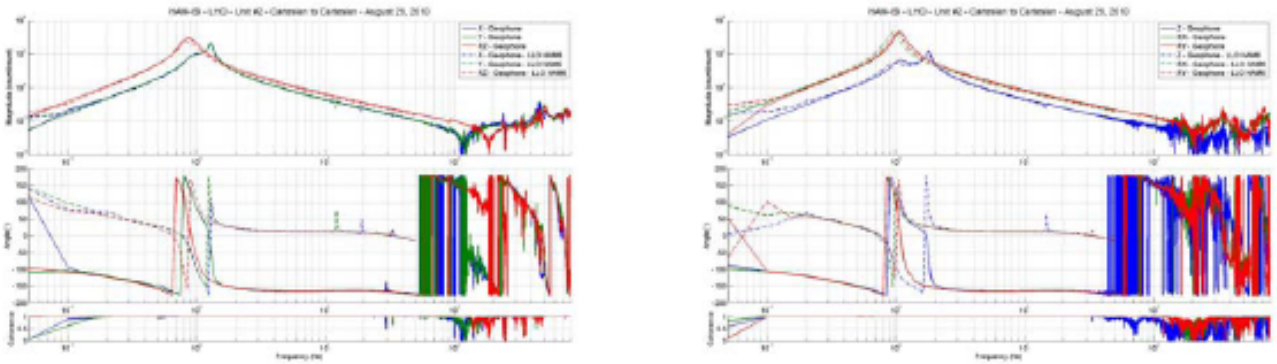


Figure - Cartesian to Cartesian measurements comparison with HAM6 – GS13

E1000488
aLIGO BSC-ISI Testing Procedure, Phase III
(After insertion, commissioning in the chamber)

Step_5_Damping_Loops_ST2_LASTI_Prototype_BSC_ISI

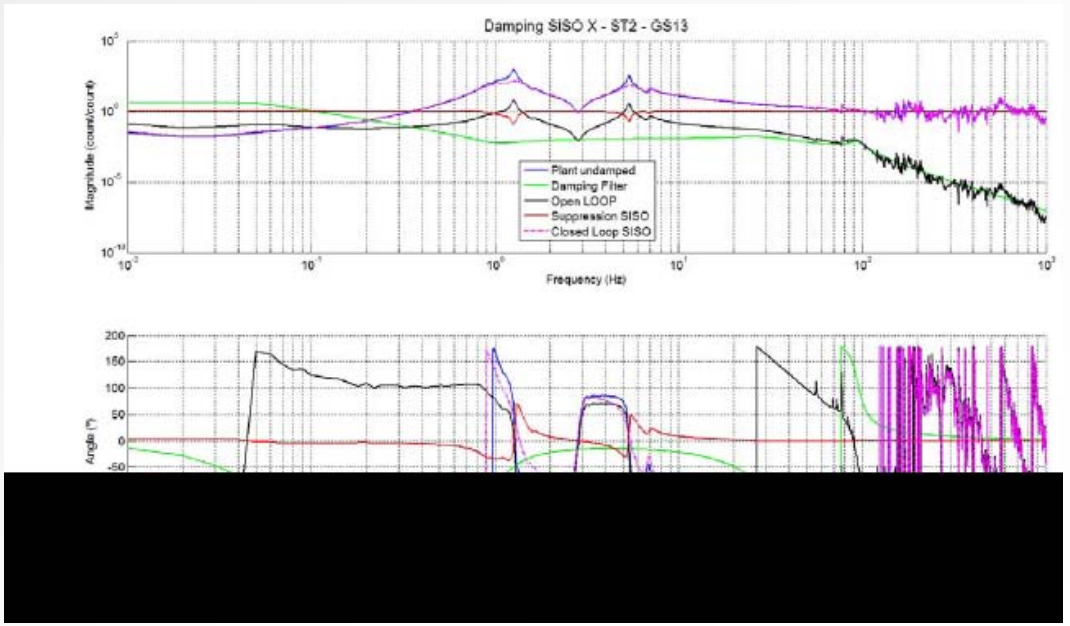
During this step, damping filters of stage 2 are designed. In details, this script:

- Loads the Cartesian to Cartesian transfer functions of the undamped structure (measured or simulated).
- Computes the gain of the damping filters. Filters are designed in a SISO configuration. The filters shape (poles and zeros) is the same for every DOF and for every unit.
- Computes the SISO and the MIMO transfer functions when the Damping Filters of stage 1 are engaged

If isolation and damping filter are engaged, the control drive transfer functions are given by:

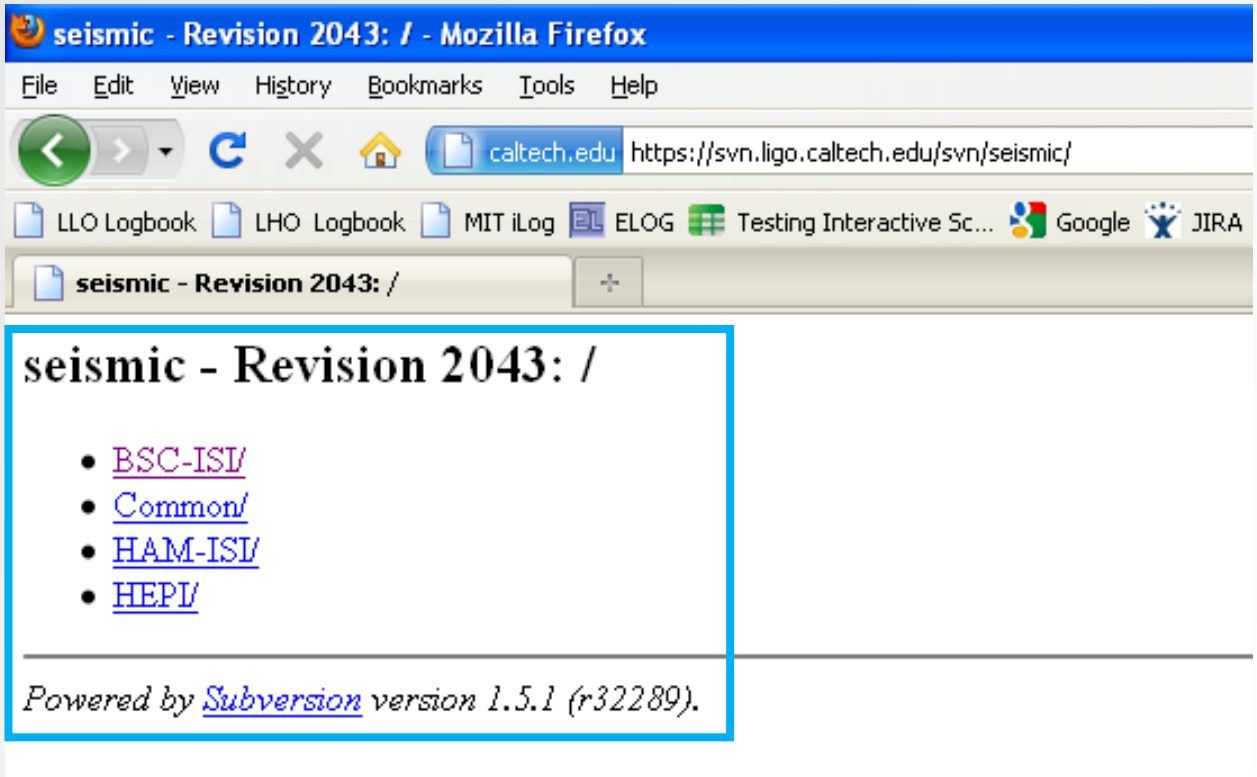
$$U_1/Exc = [TF_{C2C}CPS_{CS} * CPS_{Blend\ CS} + TF_{C2C}GEO_{CS} * GEO_{Blend\ CS}] * Controller_{S1} + TF_{C2C}GEO_{CS} * Damping_{S1}$$

$$U_2/Exc = [TF_{C2C}CPS_{FN} * CPS_{Blend\ FN} + TF_{C2C}GEO_{FN} * GEO_{Blend\ FN}] * Controller_{S2} + TF_{C2C}GEO_{FN} * Damping_{S2}$$



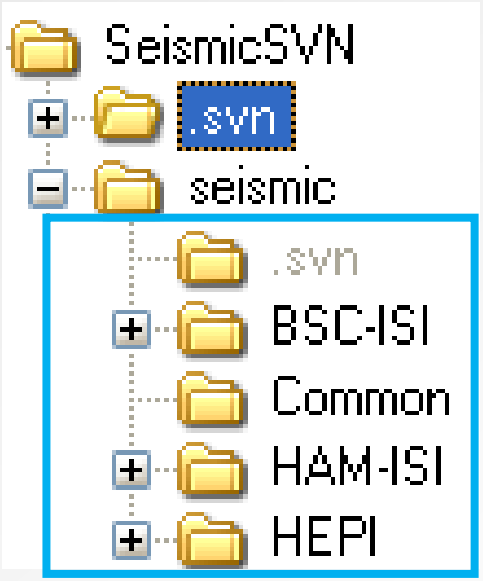
2) Seismic SVN Tree Description

https://svn.ligo.caltech.edu/svn/seismic/

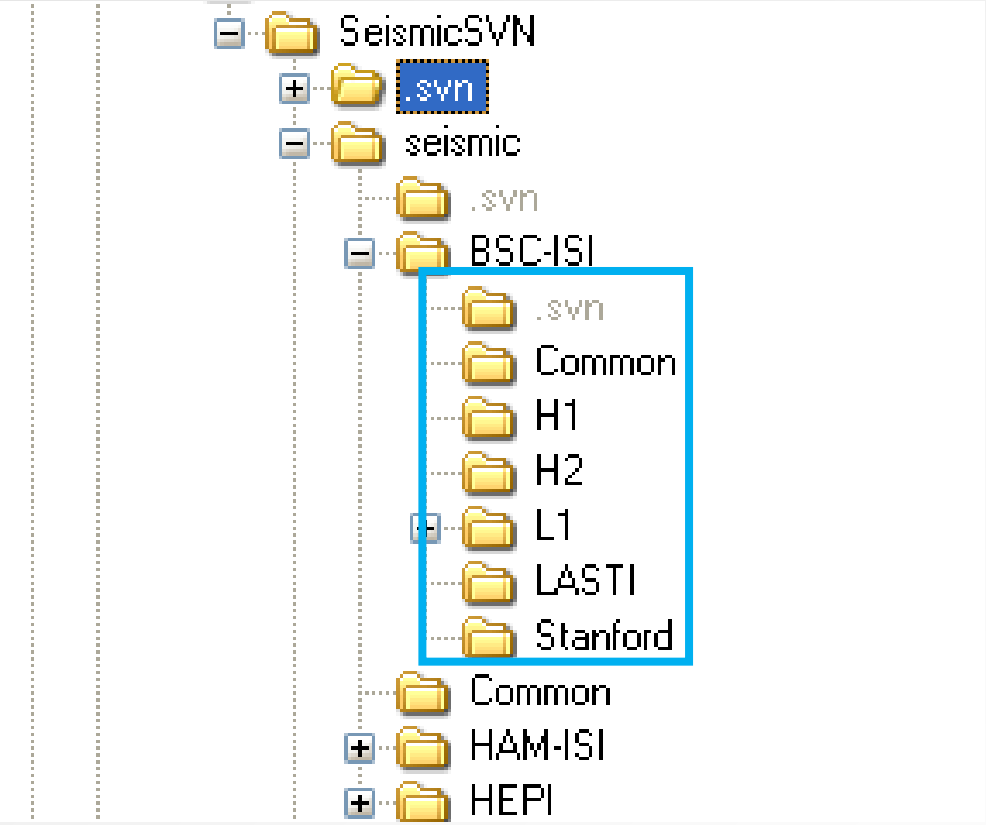


Seismic SVN Tree Description

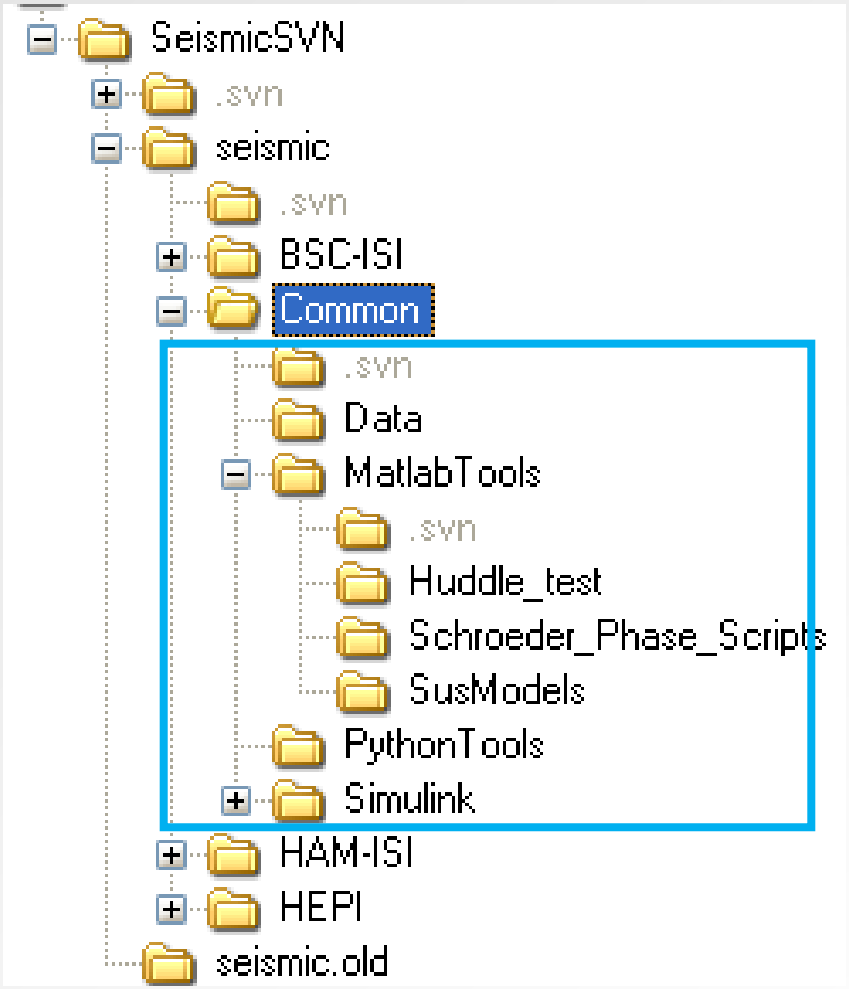
Level 1: Module/



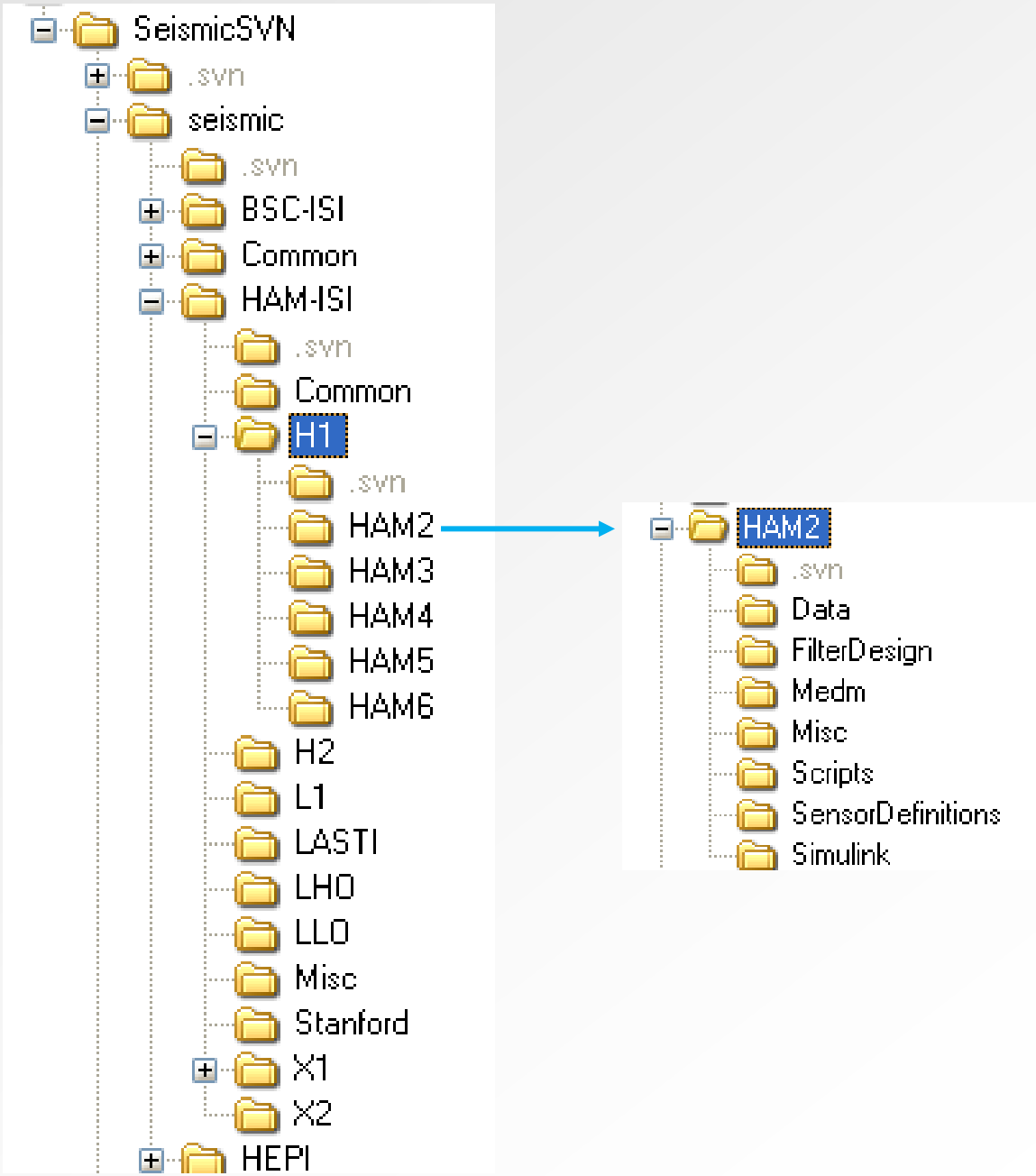
Level 2: Module/Site/



Level 2: Module/Common/



Level 2: Module/Site/Units



SEI Svn Reference document or wiki

- Instructions
- Recommendations

- Always use svn commands: svn mkdir, svn add, svn move…

- Case sensitivity

- FAQ

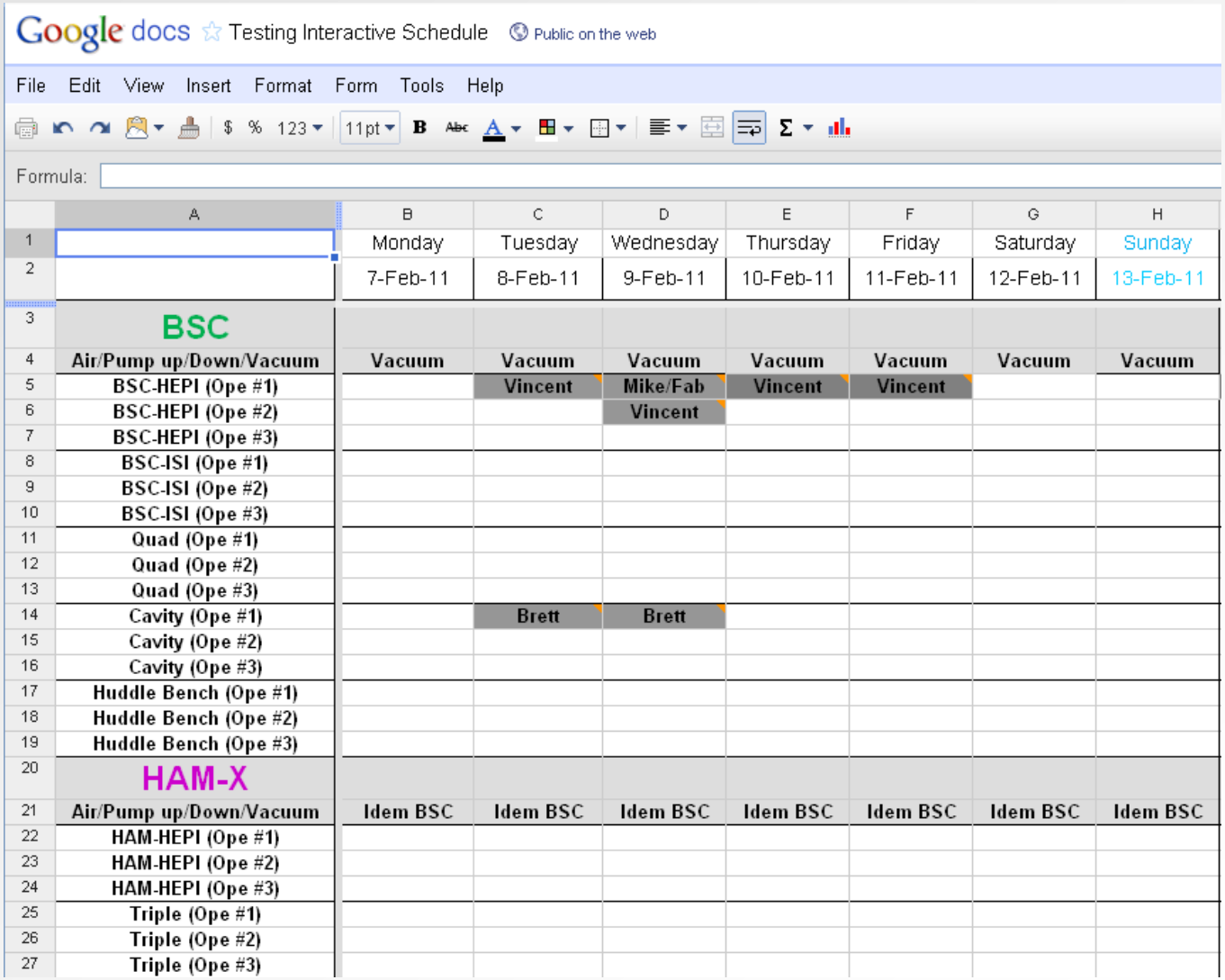
i.e. What happen if I check out instead of updating?

3) Testing Interactive Schedule

- Which module is being used
- For how long. Measurement Done.
- What type of tests
- Contact information
- Goal is to help with testing organization.
- Still very important to communicate.
- Must be simple to use
- Interactive, Online

Online Interactive datasheet

https://spreadsheets.google.com/ccc?key=0AnuzOkrYewP3dHVjVnNSZ0Vtc2VVeUNIZDVZNkcyb2c&hl=en#gid=9



Google docs ☆ Testing Interactive Schedule — Public on the web

File Edit View Insert Format Form Tools Help

Formula:

	A	B	C	D	E	F	G	H
1		Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
2		7-Feb-11	8-Feb-11	9-Feb-11	10-Feb-11	11-Feb-11	12-Feb-11	13-Feb-11
3	BSC							
4	Air/Pump up/Down/Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
5	BSC-HEPI (Ope #1)		Vincent	Mike/Fab	Vincent	Vincent		
6	BSC-HEPI (Ope #2)			Vincent				
7	BSC-HEPI (Ope #3)							
8	BSC-ISI (Ope #1)							
9	BSC-ISI (Ope #2)							
10	BSC-ISI (Ope #3)							
11	Quad (Ope #1)							
12	Quad (Ope #2)							
13	Quad (Ope #3)							
14	Cavity (Ope #1)		Brett	Brett				
15	Cavity (Ope #2)							
16	Cavity (Ope #3)							
17	Huddle Bench (Ope #1)							
18	Huddle Bench (Ope #2)							
19	Huddle Bench (Ope #3)							
20	HAM-X							
21	Air/Pump up/Down/Vacuum	Idem BSC	Idem BSC	Idem BSC	Idem BSC	Idem BSC	Idem BSC	Idem BSC
22	HAM-HEPI (Ope #1)							
23	HAM-HEPI (Ope #2)							
24	HAM-HEPI (Ope #3)							
25	Triple (Ope #1)							
26	Triple (Ope #2)							
27	Triple (Ope #3)							

User Guide

	Monday	Tuesday	Wednesday
	18-Oct-10	19-Oct-10	20-Oct-10
Chamber 1			
Air/Pump up/Down/Vacuum	Vacuum	Vacuum	Vacuum
Module 1 (Ope #1)			User 1
Module 1 (Ope #2)			
Module 1 (Ope #3)			
Module 1 (Ope #1)	User 1	User 1	
Module 1 (Ope #2)	User 1		
Module 1 (Ope #3)			
Module 1 (Ope #1)			User 2
Module 1 (Ope #2)			
Module 1 (Ope #3)			
Chamber 2			
Air/Pump up/Down/Vacuum	Vacuum	Vacuum	Vacuum
Module 1 (Ope #1)	User 3	User 3	User 3
Module 1 (Ope #2)		User 4	
Module 1 (Ope #3)			
Module 1 (Ope #1)			User 3
Module 1 (Ope #2)			
Module 1 (Ope #3)			

General Decription:

- The goal of the table is to indicate when you plan, start and finish to work on a module
- The table on the left illustrate an example of interactive planning
- This example contains 2 chambers and 3 modules
- Up to three operations a day can be recorded for each module
- Information related to an operation is contained in the "comment" associated with the cell. To make it appear, let the cursor on the cell for a fraction of seconds.
- An operation can be a hardware intervention, a series of test, a series of measurements...
- If you have more than three operations in one day on the same module (e.g. many tests), just group them
- The table is public on the web
- You need to be on the user list to have write access

To be added to the user list:

- Create a google account
- Send you google account address to Fabrice: fabrice@ligo.mit.edu

How to proceed to indicate an operation:

1) Copy paste an existing cell (one of yours if there is one)
2) Change the color to white, meaning the operation is planned
3) Double left click to change the user name in the cell (if applicable)
4) Click in the yellow comment window associated with the cell, and fill the fields:
   - Operation Start date
   - Estimate end time. For example "8.a.m. (+1 day)" for a measurement finishing the day after in the morning.
   - Contact information
   - Operation Brief description
5) Change the Cell color to orange when you actually start the operation
6) Change the Cell color to dark grey when the operation is finished

Color Code:

User Name White Cell means the operation is planned

[redacted]