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***Attach the Task Hazard Analysis (THA) related to this procedure**

Issue Date:		**Expiration Date:**	
(No more than three years from Issue Date except TOSP which is three months from issue date)			
Title:	**Qweak Liquid Hydrogen Target**		
Location:	Hall C		
Risk classification (See *ESH&Q Manual Chapter 3210 Appendix T3 Risk Code Assignment*.)	**Without mitigation measures (3 or 4):**	3	
	With mitigation measures in place (0, 1, or 2):	1	
Document Owner(s):	Greg Smith	**Date:**	June 11, 2010

Supplemental Technical Validations:

Hazard Reviewed (per ES&H Manual 2410-T1):	Subject Matter Experts Signature:	Date:
Fire Protection: Dave Kausch		

Approval Signatures:

	Print	Signature	Date:
Division Safety Officer:	Dennis Skopik		
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	J.P. Chen		
	Bert Manzlak		
	Dave Kashy		

Document History:

Revision:	Reason for revision or update:	Serial number of superseded document

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1. Purpose of the Procedure

Qweak Liquid Hydrogen Target OSP.

2. Scope – include operations, people, and/or areas where procedure applies

The scope of this document includes operation of the Qweak liquid hydrogen target in Hall C whenever liquid hydrogen is condensed in the target. The people affected by this OSP are the Qweak target operators trained according to the rules described in http://qweak.jlab.org/doc-public/ShowDocument?docid=1206.

3. Description of the Facility: (include floor plans and layout of a typical experiment or operation)

The 55 liter Qweak liquid hydrogen (LH2) target is located 5.7 m downstream of the Hall C standard pivot. The target is described in detail in the Qweak Design and Safety Document (DSD) at http://qweak.jlab.org/doc-public/ShowDocument?docid=1041. The “P&I diagram” showing the key plumbing for the target’s coolant as well as hydrogen circuits is available on the JLab Oce, drawing number 67503-01000.

At the request of the reviewers, a final as-built drawing of the target loop will be added to OCE. Work on this drawing will start once the target has been commissioned.

The gas panel requires a source of hydrogen to pump and purge with and to provide more gas to the system when required. Only one full hydrogen bottle will be in Hall C at any given time for this purpose. In addition, no loads will be craned over the top of this bottle whenever the bottle is full or in use.

4. Authority and Responsibility:

4.1 Who has authority to implement/terminate

The JLab target group (Chris Keith, Dave Meekins, Josh Pierce), Hall C leader (Steve Wood), Silviu Covrig, and Greg Smith.

4.2 Who is responsible for key tasks

Target installation and repair is under the control of the JLab target group. Hall C technicians will install the scattering chamber. Hydrogen sniffers are controlled by the JLab target group. Operation once the target is installed is a Hall C responsibility (Greg Smith is the current Hall C target liaison). Delivery of helium coolant to the Hall C WBS 7 distribution can is the responsibility of the JLab cryo group. Target training is the shared responsibility of Greg Smith and Silviu Covrig. Day to day (24/7) operation monitoring and control of the target whenever

Serial Number: ______________________________

(Assigned by ESH&Q Document Control x 7277)

hydrogen is condensed in the target is the responsibility of the trained Qweak target operators.

5. Who analyzes the special or unusual hazards (See ES&H Manual Chapter 3210 Appendix T1 Work Planning, Control, and Authorization Procedure)

A detailed hazard analysis is contained in Chapter 7 of the Qweak design and safety document: http://qweak.jlab.org/doc-public/ShowDocument?docid=1041. The target underwent a design and safety review by a committee of experts including external scientists in September 2009. Their preliminary report along with the collaboration's responses can be found at http://qweak.jlab.org/doc-public/ShowDocument?docid=1062. Their final report can be found at http://qweak.jlab.org/doc-public/ShowDocument?docid=1143. Independent of this, each of the target components has been reviewed by the JLab ASME pressure vessel committee. The design authority for the Qweak target Dave Meekins can provide the relevant documentation.

6. Personal and environmental hazard controls including:

6.1 Shielding

Concrete, lead and tungsten shielding exists on the downstream side of the target.

6.2 Interlocks

Target motion is interlocked to the FSD system. A vacuum switch shuts off the power to the target pump and the target heater if the insulating vacuum in the scattering chamber is above a few Torr. This vacuum switch also closes a small breather tube preventing hydrogen gas from flowing back from the storage tanks to the hall in the event of a loss of vacuum. Gate valves on either side of the scattering chamber close if the vacuum rises above $5x10^{-5}$ Torr. The gate valve downstream of the scattering chamber is upstream of the scattering chamber thin window. This valve will close whenever hydrogen is condensed in the target and the hall is in restricted or controlled access, eliminating the thin window from the secondary containment system of the scattering chamber whenever personnel are in the hall. Separate ion chambers viewing (among other areas) mainly beam-target interactions, as well as beam interactions with the beam collimating tungsten plug just downstream of the target are also part of the FSD system for this experiment.

The target relies on a functioning FSD for the fast raster magnet currents as well. For this experiment a new (additional) raster protection signal has been added which generates an FSD if more than 10-20 µA of beam is delivered to the hall when the raster is off. This is to protect the vacuum window at the end of the Hall C beamline (at the entrance to the Hall C dumpline). This dual, water filled window was specially engineered (see http://qweak.jlab.org/doc-public/ShowDocument?docid=1222) to safely withstand up to 180 µA of rastered beam (4x4 mm^2 at the target, which corresponds to 8x8 mm^2 at the dump viewer vacuum window) but was not designed to withstand that much unrastered beam. To help protect the target from a failure of this window, this new FSD signal was provided in case unrastered beam is accidentally delivered at high current.

6.3 Other

One of the main concerns we (still) hear from the review committee has to do with preventing freezing of hydrogen in the heat exchanger, a concern fueled by the use of 4 K helium coolant in the target heat exchanger even though hydrogen freezes at 14 K. We have done a number of things to address these concerns, as explained in the target DSD and in the target training talk.

However, in addition to the measures we have already undertaken, we will commission a new safety measure which we think ought to take this concern off the table once and for all. Our plan is to set up a PID loop which looks at a hydrogen temperature sensor, and close the 4 K supply JT valve *automatically* if the loop temperature falls below some threshold value like 17 or 18 K. This PID loop ought to then prevent the loop from freezing even if the target operator has somehow fallen asleep or died at the console. We don't promise to have this working from day one- it has to be implemented carefully to avoid crashing the CHL. The PID has to change the JT slowly enough to keep the CHL alive, and it has to be robust enough not to trigger on IOC reboots or occasional dropped bits reading the TS, or other false alarms. However once it is properly set up it will provide constant and automatic protection from freezing the hydrogen in the loop.

At the request of the review committee, we agree to do two more things:

- The 4K JT PID will be made a "cascading" PID, so that other conditions can be applied to close the valve.
- A hydrogen pressure (PT9) threshold will be applied to the FSD system, so that if the hydrogen pressure (differential pressure across the pump) falls significantly, an FSD will be generated. This is to address the reviewers' concern that if the hydrogen pump fails, the hydrogen liquid will boil away, reducing the effectiveness of convective heat transfer at the target cell windows. The beam should go off if this happens, to avoid the remote possibility of burning through the windows. The pressure FSD should insure the beam goes off even if the target operator fails to act.

7. Monitoring systems

The target monitoring and control system is described in Chapter 5 of the design and safety document (http://qweak.jlab.org/doc-public/ShowDocument?docid=1041), and in the target operator training talk at http://www.jlab.org/%7Esmithg/target/Qweak/Qweak%20Tgt%20Training.pdf. Temperatures and pressures of the hydrogen circuit and helium coolant lines are read out in multiple places. Heater voltage and current are also read out by the target control system. Pump voltage, current, frequency and head are read out. The target position along both axes is read out via the respective stepper motor values as well as with resistive encoders. Temperatures associated with the pump, the horizontal motion motor, and the solid target ladder are monitored. The scattering chamber vacuum is also read out.

The control system runs in the Hall C counting room where there is a trained target operator present whenever hydrogen is condensed in the target. In addition, a target expert is on call 24/7 whenever hydrogen is condensed in the target.

Internet security is as follows: To access the target control system from offsite, a person must first login to login.jlab.org with their JLab username and password. From there one can then (and only then) login to a counting house computer with a common username and password shared by all the target operators. Remote login is discouraged for all but the target experts, and changes are to be made only by the local target operator except in highly unusual situations, and only then when the remote expert is in direct communication by phone with the local target operator in the Hall C counting room.

8. Ventilation

There is no ventilation other than the relief and vent systems touched upon in 6.3.

9. List of safety equipment (i.e: personal protective equipment or special tools)

No special PPE is required. Work on the target after beam has been in the hall may require a job-specific RWP. This determination will be made by RadCon. Access to the target is via a small platform with railings.

10. Associated administrative procedures

Warmup and cooldown procedures follow MCC-PR-06-006 (http://opsntsrv.acc.jlab.org/ops_docs/online_document_files/MCC_online_files/HallC_15K_cooldown.pdf) and MCC-PR-06-005 (http://opsntsrv.acc.jlab.org/ops_docs/online_document_files/MCC_online_files/HallC_4_5K_cooldown.pdf). Operational restrictions on the beam current and raster size for each target are at http://opweb.acc.jlab.org/internal/ops/ops_webpage/restrictions/ops_restrictions.html. The gas handling guide http://qweak.jlab.org/DocDB/0012/001226/001/ghs.pdf will provide the target experts with a checklist of steps to perform at the target gas panel when warming up, cooling down, pumping and purging, or parking the hydrogen lines of the target. Procedures for pumping, purging and recertifying the target's helium coolant lines can be found at

Serial Number: ________________________________

(Assigned by ESH&Q Document Control x 7277)

http://qweak.jlab.org/doc-public/ShowDocument?docid=1211.

11. Operating guidelines

The target is designed to operate at 35 psia and 20K. It should not be operated below 19K (hydrogen freezes at 14K). It boils at 23.6K at the 35 psia operating pressure. The pressure should not be allowed to go sub-atmospheric while the loop is cold in order to mitigate the possibility of air leaking into the system and freezing. The maximum expected pressure in the hydrogen components is 80 psia, as described in detailed calculations found in the Qweak target design and safety document http://qweak.jlab.org/doc-public/ShowDocument?docid=1041). The design frequency for the hydrogen circulation pump is 30 Hz. At least 100 W of heater power should always be present on the heater whenever the target is cold in order to regulate its temperature. The 35 cm long LH2 target was designed to handle up to 180 µA of 1.165 GeV electrons, corresponding to a total beam power of 2.1 kW, with a beam raster area of (at least) 4x4 mm^2. The internal target heater was designed to provide up to 3 kW. Approximately 2.3 kW of cooling power will be required for the target under normal running conditions at 150 µA. Alarm limits will be set by the target experts for all crtical target parameters. Alarm response is part of the target operator training. Beam current and raster size restrictions for each target that's part of the Qweak experiment can be found in the JLab operational restrictions web page at http://opweb.acc.jlab.org/internal/ops/ops_webpage/restrictions/ops_restrictions.html.

12. Notification of Affected Personnel (How and Who)

A list of target experts is made available on the target web site (http://www.jlab.org/%7Esmithg/target/Hall_C_Cryotarget.html) as well as at the target control station in the Hall C counting room. The list explains who to call in what order, and provides phone and pager numbers. The target experts (aka target black belts) are Greg Smith, Silviu Covrig, Dave Armstrong, Dave Meekins, Chris Keith, Josh Pierce, and Jim Dunne. The experts will be called if necessary by the target operators who staff the target controls in the Hall C counting room 24/7 whenever hydrogen is condensed in the target. Target brown belts will help during the break-in periods to help train other Qweak target operators, as described in the target training requirements (see http://qweak.jlab.org/doc-public/ShowDocument?docid=1206). Brown belts include the black belts plus Mark Jones, Dave Armstrong, and Peter Bosted.

13. List of steps required to execute the procedure from start to finish.

See 10.

14. Back out procedures, i.e., steps necessary to restore the equipment/area to a safe level.

See 10.

Serial Number: ______________________________

(Assigned by ESH&Q Document Control x 7277)

15. Special environmental control requirements:

None.

16. Environmental Impacts (See EMP-04 Project/Activity/Experiment Environmental Review

None. If the primary relief system fails, the secondary vent system will vent hydrogen gas into the atmosphere through the parallel plate relief valve located outside the Hall C truck ramp.

17. Abatement Steps – Secondary Containment, or Special Packaging requirements

The liquid hydrogen circulates in a 55 liter loop nominally at 20 K and 35 psia, which is always connected to ballast/storage tanks outside the hall when hydrogen is condensed. Redundant relief paths are provided on both sides of the heat exchanger and both sides of the hydrogen pump. The primary relief connects the hydrogen return line from the target to ballast tanks (6000 gallons total) outside the hall through a primary 2" check valve (CV12). Flow from the ballast tanks back to the hall is prevented in the event of a loss of scattering chamber vacuum via a pneumatic valve (PV12) actuated by a vacuum switch. The hydrogen return line has a redundant, separate relief path via a 60 psig relief valve (RV4) in parallel with a 2", 75 psig rupture disk (RV2), then through a 2" check valve into a helium inerted vent line which goes outside Hall C to a parallel plate relief valve which can vent the hydrogen to atmosphere in case the primary relief path to the ballast tanks fails. A third and even fourth level of redundancy is provided by separate 80 psig relief valves on both the hydrogen supply (RV7) and return (RV6) lines, which relieve the hydrogen into a large, 6" diameter vent line which runs up the Hall C truck ramp and vents outside the hall through a parallel plate relief. This 6" vent line is inerted with nitrogen.

All four relief and vent systems mentioned above protect the integrity of the recirculation loop. Stated differently, there is quadruple redundancy for relief of the loop. If the loop integrity were compromised, we rely on our secondary containment system. The secondary containment is the vacuum system surrounding the target, which is isolated from the thin windows of the target scattering chamber whenever personnel are in the hall and hydrogen is condensed, or whenever the scattering chamber vacuum deteriorates as would be the case if the loop integrity fails. This vacuum system consists of the target scattering chamber along with a 1060 gallon vacuum dump tank specifically provided to passively absorb the pressure rise resulting from the liquid to vapor phase transition in the event hydrogen ever gets loose in the vacuum system. The vacuum dump tank is part of the secondary containment. From there a separate vent system is provided to route the expanding hydrogen vapor out of the scattering chamber through a relief tree consisting of three 2" check valves (CV11A, B, &C) and a 4", 8 psig rupture disk (RD2) all in parallel into the 6" vent line mentioned earlier. The pressure rise expected if this system ever were to see hydrogen is considerably less than 15 psig.

In the event of a failure of the target cell window, for example, hydrogen would get into the secondary containment system. The scattering chamber vacuum would spoil, which would trip off the target circulation pump and heater, the turbopumps, and close the gate valves upstream and downstream of the target. Although the thin vacuum window in the secondary containment is designed to handle the pressure anticipated in this kind of an accident, it would never see this pressure because it would be isolated by the closed gate valve between it and the target. PV12 would also close, preventing the hydrogen inventory still in the ballast tanks (about 50,000 STP liters) from flowing back to the target's secondary containment system. Check valves CV11A, B, & C would open, allowing the hydrogen gas to flow out of the secondary containment into the inerted 6" vent line to the parallel plate relief valve outside the Hall C truck ramp. The vent line and secondary containment pressure will not rise above 8 psig. If it somehow managed to reach 8 psig anyway, the large diameter rupture disk RD2 would also relieve into the vent line, in parallel with CV11, preventing the pressure from rising above this. After the event, there would be 1 atm of 300 K hydrogen vapor in the secondary containment system, the hydrogen loop and its plumbing, and the 6" vent line. The 6" vent line would be pumped out through MV26. The hydrogen loop would be pumped out through VP1, and the rest of the secondary containment would be pumped out primarily through VP2 (VP1 and VP2 would "talk to each other" through the failed window). The system would then be inerted and the broken window would be replaced.

18. Training requirements

See http://qweak.jlab.org/doc-public/ShowDocument?docid=1206. Initial training consists of a target training lecture which must be attended in person, and a practical conducted in the counting room with a cold target. The lecture slides are part of the target operator's inventory of tools, it can be accessed at http://www.jlab.org/%7Esmithg/target/Qweak/Qweak%20Tgt%20Training.pdf. The training slides include the recommended response to off-normal events.

19. Unusual/Emergency procedures e.g., Injury, Fire, Loss of power

These are described in Chapter 7 of the Qweak DSD, at http://qweak.jlab.org/doc-public/ShowDocument?docid=1041. They are also covered in the target training lecture (see http://www.jlab.org/%7Esmithg/target/Qweak/Qweak%20Tgt%20Training.pdf). However the Qweak target design and safety review committee recommended that we amplify on some of those procedures in this document. In particular, the committee requested that we specifically address the following off-normal event procedures in this OSP:

1. **The response to a non-target fire in the experimental hall:** The response to this incident should be to first sound the fire alarm, evacuate Hall C and call 911, 4444, and the MCC. Then close the gate valves on both sides of the scattering chamber, close both JT valves, and initiate a formal warm-up of the target from the Hall C counting room.
2. **Response to a complete or partial failure of power in the hall**: A complete failure is not a problem, since the target will simply warm up slowly and safely all by itself. If the power failure is only partial then the operator should monitor the target and close the JT valves to stop the flow of coolant in the unlikely condition that the hall loses power but coolant is still being delivered. It is absolutely essential that the target IOC and control computer be on UPS, along with the temperature sensors and JT controls, so that the target can be monitored and the JT valves closed remotely from the Hall C counting house. When the hall loses power, the pump and the heater will stop. The gate valves on either side of the target will close (they fail closed). The insulating vacuum will begin to spoil which will eventually lead to a target warmup/boiloff. Note also that as described in section 6.3, a "deadman's switch" consisting of a temperature based PID on the 4 K JT valve will kick in to insure the 4 K helium coolant supply is cut off.
3. **Pump motor failure:** This is not a safety issue. If the pump stops, the target temperature will dip at first, then climb to the vapor pressure curve. The PID will have shut off the heater. Typically it will sit on the vapor pressure curve for around 20 minutes before all the liquid has boiled away and the vapor warms up over many hours to room temperature. If the pump trips, the pump should be reset from the GUI. If that fails to resolve the problem, the breaker next to the pump controller (in the same electronics rack) in Hall C should be reset. If the pump has failed because of some larger issue, the target will warm up and experts will have to replace or repair the pump.
4. **Open or shorted heater coils:** There are two heater coils in parallel, so if one goes open the other can carry on. There are two heater power supplies, so if one fails the other can be used to control the heater manually. If the heater shorts, or if the leads to the heater go open circuit, the heater will be inoperable. Then the JT valves must be closed, and the target should be warmed up for repairs. Note that because two relief lines are provided on either side of the heater and either side of the pump, even if (hydrogen) ice were to form in the loop (presumably in the heat exchanger) in such a way as to block the flow of gas, the system would still relieve safely through one side or the other (or both) of the blockage.
5. **Faulty temperature or pressure readings:**
    a. *High temperature*: Turn off the beam. Check the other temperature sensors (TS) to see if the alarm is from a single faulty thermometer or not. Also check the analog temperature readout in the counting room. If it's just one TS, it has been radiation damaged and can be ignored, there are 9 other TSs in the loop. If the

damaged TS is the one being used for the heater PID, change to a different PID TS. The alarm may be due to a hydrogen pump trip- reset the pump. The heater should be at zero- if not turn it off. Check the scattering chamber vacuum. If it has gone bad go into Hall C as soon as possible on an escorted access and reset the turbopump that has tripped. If it is not a turbopump problem there may be a leak in the system which will require the target be warmed up and the leak repaired. Finally, check the coolant supply temperatures. Either one or both of the refrigeration plants may have crashed, or the insulating vacuum in the transfer lines may have gone soft. Reboot the target IOC, call an expert.

b. _Low temperature_: Leave the beam on- if it trips, OK. Check the other TSs and analog temperature readouts as in 5a. The heater should be railed. Check that the PID is working. Use the second (manual) heater power supply to restore the temperatures while you debug the problem. The normal temperature range can also be restored by reducing the JT valves until the temperature is brought back to normal. Check that the ESR supply temperature has not fallen dramatically. If it has, reduce the 15K JT valve until the temperatures stabilize again. Reboot the IOC, call an expert.

c. _Low pressure alarm_: If the temperatures are also well below normal then see 5b. Otherwise, this alarm is usually just a natural diurnal pressure variation from the sun heating the ballast tanks outside. Check this with the archiver to see if the temperature excursion is normal relative to that archived over the past few days. Normal variations are 2 or 3 psi about the goal value of 35 psia. It can also happen that PV12 has closed and the system can't breathe. In that case the natural diurnal pressure variations effectively pumps hydrogen out of the target to the ballast tanks. If the scattering chamber vacuum is OK, then open PV12. If not, then leave PV12 closed. Check for vacuum problems in Hall C (tripped turbopumps). Reset the pumps. If this is not the problem hydrogen may have leaked into the scattering chamber. Call an expert, who will warm up the target. Also reboot the IOC to make sure that is not the problem.

d. _High pressure alarm_: Check with the archiver as explained in 5c to see if this is a natural diurnal pressure variation. Check if the temperatures are also high. If they are then see the high temperature procedures in 5a. If they continue to rise the target is warming up. The expected warm storage pressure is 66 psia. Reboot the IOC. Call an expert.

We were also handed a sheet of questions by John Domingo on June 2, 2010 titled "Points for Qweak Target Review". We address these now:

Serial Number: ______________________________

(Assigned by ESH&Q Document Control x 7277)

1. *Monitor the current to the heater*: The heater current is read out and can be monitored by the target operator in the counting room from the heater GUI. It will also typically be stripcharted along with other key target parameters on the target operator's computer console.
2. *Are the heater supplies on UPS?* No, they are 3 kW heaters and they will not operate if power is lost. The response to a power failure is described in 2 above. *How is the switch made to the standby supply; a manual switch I hope?* The standby supply is wired in parallel to the output terminals of the primary supply. It is powered on all the time, but its output is controlled by a pot in the Hall C counting room. A (covered) switch is provided in the counting room (next to the pot) to activate the pot. Typically the pot is left at the setting last used and the switch is simply flipped on to immediately energize the heater with the power used the last time the secondary supply was engaged. One simply adjusts the pot in the counting room to pump current from the secondary supply into the lines going to the heater. In case the target IOC is sick, or is being rebooted, analog temperature readout in the counting room is provided next to the manual heater pot so that the target operator can "ride" the manual heater control pot while looking at the analog temperature readouts to keep the target liquefied and close to its goal parameters. This allows the target operator to maintain (manual) control of the target temperature even in unusual situations where computer control is lost.
3. *Will the important temperature sensors read even if the hall power fails?* Yes, the temperature sensors, JT valve controls, target IOC and target control computer all must be on UPS.
4. *What are the automatic actions taken if the pump fan fails?* See 3 above. The pump should be reset quickly to avoid a lengthy down time to recondense the hydrogen. However it is not a safety issue. If the pump fails, the heat exchanger efficiency will drop and hydrogen will warm up and boil off safely. Relief paths on both sides of the pump (and the heat exchanger) insure the system can relieve safely even if the pump has stopped due to a blockage of some kind. *How is its normal operation monitored?* The pump parameters (pump voltage, pump current, pump frequency, pump head) are available in the target control GUI. Typically the pump parameters are strip charted along with strip charts for other key parameters like hydrogen temperatures and pressures, etc. Alarms are placed on the pump frequency. Alarms on the temperature and pressure of the hydrogen also will sound if the pump fails.
5. *There should be a list of emergency actions to be taken to prevent freezing of the target. This is more important than just target boil off.* Yes. We provided a list of emergency actions in Chapter 7 of the Qweak DSD, available at http://qweak.jlab.org/doc-public/ShowDocument?docid=1041. They are also covered in the target training lecture (see http://www.jlab.org/%7Esmithg/target/Qweak/Qweak%20Tgt%20Training.pdf). In

addition a subset of our off-normal event responses is included above at the request of the Qweak target design and safety review committee. Finally we note that we have added the “deadman’s switch” described in section 6.3 above to act as a failsafe against ever freezing the target.

6. *Address the feasibility of controlling the temperature by regulation of only one JT valve; this would make the manual adjusting much simpler.* Agreed. Because of the greater sensitivity of the CHL, and the greater impact of a CHL crash if the target operator changes the 4 K JT valve too quickly, the preferred method when small adjustments to the cooling power are required is to adjust the ESR 15 K JT valve, and leave the CHL JT valve alone as much as possible. However, we do not think we can hard-wire this into the target training, because we have already agreed with the laboratory to stay flexible, and maintain the ability to dynamically balance our coolant load on the CHL versus that on the ESR. We have to be able to operate with most of our cooling power coming mostly from the CHL, or mostly the ESR, or a combination of both in consultation with the cryo group in order to find the balance most conducive to smooth operation of the other halls. The target experts will instruct the target operators dynamically on the best way to adjust the JT valves given whatever balance has been struck with the laboratory. The default preference is to make adjustments with a single JT valve, the 15 K ESR JT valve, as much as possible.
7. *The target audible alarm should be distinctive so not easily ignored.* Yes, this has been a bit of a problem in the past since the PC speaker we use is not very loud. We set the volume at maximum, and the beep frequency and duration to a distinct pattern with the command “xset b [vol [pitch [dur]]]” where the volume is in percent, the pitch is in Hz, and the duration is in milliseconds.
8. *Check for red green color blindness among potential target operators. See if another color pair would be better.* We know we have at least one target operator who is color blind, and this person is someone we want to keep in the target operator ranks because of the respect we have for his abilities as a scientist. We think the red green pattern we have is the right choice because all the target operators who are not color blind recognize and interpret these colors best. We point out that the display of colors that are keyed to alarm conditions is a handy but unnecessary feature. It was not provided in the past, it is something we started using during G0 and was added as a “bell and whistle”. What is essential is that the target operator be able to see and hear the alarm GUI. The target training makes it clear that this alarm GUI must be visible in all workspaces of the target operator’s computer. The cue for an alarm is the beeping, and the flashing of this main EPICS alarm GUI. The response the target operators are trained to perform is to click on the main alarm GUI, which brings up the alarm tree, and from there the alarm branches which display the value of the parameter which generated the alarm, as well as

Serial Number: ______________________________

(Assigned by ESH&Q Document Control x 7277)

the inner and outer alarm limits. With that information in front of the target operator, colors are unnecessary.

20. Instrument calibration requirements, e.g., safety system/device recertification, RF probe calibration

The hydrogen circuit needs to be leak checked before initial use. It must also go through a pump and purge procedure prior to each cooldown described in our gas handling procedures which can be found at http://qweak.jlab.org/DocDB/0012/001226/001/ghs.pdf. The hydrogen circuit must be pumped out and inerted with helium whenever it is to be opened for maintenance or repair. Hydrogen sniffers should be calibrated bi-annually. Coolant transfer line insulating vacuum spaces should be checked and pumped out if necessary every 6 months. The helium coolant lines need to be pumped out and purged with helium gas before initial use. They must then be certified by the JLab cryo group. The coolant line pump, purge, and certification procedures are described in http://qweak.jlab.org/doc-public/ShowDocument?docid=1211. Whenever the target has warmed up, the hydrogen pump controller and heater power supplies must be turned off in Hall C.

21. Inspection schedules

This OSP serves the function of the final safety approval of the Qweak target.

22. References/Associated Documentation

The Qweak target design and safety document can be found at http://qweak.jlab.org/doc-public/ShowDocument?docid=1041. The ASME design authority for the Qweak target is Dave Meekins. Documentation relating to ASME compliance are on Docushare and can be provided by the design authority. Many other references, associated documentation, and various other useful links related to the Qweak target are available on the Hall C cryotarget web page, Qweak section, at http://www.jlab.org/%7Esmithg/target/Hall_C_Cryotarget.html#QwTgt. Finally, the entire set of target related documentation is posted to the Qweak document database at http://qweak.jlab.org/doc-public/ListBy?topicid=8, and at http://qweak.jlab.org/doc-private/ListBy?topicid=8 (the latter is password protected).

23. List of Records Generated (Include Location / Review and Approved procedure)

During operation the target operators are required to post a logbook entry of the target status (usually a snapshot of the main gui and stripcharts) at least once per shift.

The list of approved target operators and their training status is maintained by Greg Smith. The training status of all Qweak target operators is posted on the Qweak target web page at http://www.jlab.org/%7Esmithg/target/Qweak/Target%20Operators.pdf.

Serial Number: ____________________

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Documents relating to ASME compliance of the Qweak target are on Docushare and can be obtained by contacting Dave Meekins.

Authorized/Trained Individuals

Print Name/Signature	Date
Greg Smith	
Silviu Covrig	
Dave Meekins	
Chris Keith	
Josh Pierce	
Jim Dunne	
Dave Armstrong	
Qweak target operators as specified at http://www.jlab.org/%7Esmithg/target/Qweak/Target%20Operators.pdf	

ISSUING AUTHORITY	APPENDIX AUTHOR	APPROVAL DATE	EFFECTIVE DATE	EXPIRATION DATE	REV.	Page 15 of 15
ESH&Q Division	Harry Fanning	10/05/09	01/01/10	10/05012	0	

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