

**NPDGamma LH2 Target OJT Lesson Plan:**

***Senior Operator for the NPDGamma LH2 Target Operators.*** Course # 38145

Version September 11, 2006

<b>Required Tasks and Knowledge</b>	Trainer initials to indicate satisfactory completion
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<p><u>Version Log:</u></p> <table><tr><td>Date</td><td>Changed content</td></tr><tr><td>July 11, 2006</td><td>Original</td></tr><tr><td>August 28, 2006</td><td>Clarification to training prerequisites, fixed Errors, and cleared text with comments</td></tr><tr><td>September 11, 2006</td><td>Typos fixed</td></tr></table> <hr/> <p><b><u>0. Introduction</u></b></p> <p>Object of this On-the-Job Training (OJT) Lesson Plan is to train Senior Operators for the NPDGamma LH2 target system. After successful completion of this OJT and authorization by line management Senior Operators can perform target operations in 1FP12 at ER2 at TA-53.</p> <p><b><u>I. Training Prerequisites</u></b></p> <p>A. In order to become a qualified Junior Target Operator, the trainee has to complete the following Laboratory training requirements:</p> <ul style="list-style-type: none"><li>• Pressure Safety Orientation Course # 769</li><li>• Hydrogen Gas Safety Course # 8724</li></ul> <p>Before handling cryogenics or gas cylinders, the trainee has to complete the following Laboratory training:</p> <ul style="list-style-type: none"><li>• Cryogen Safety Course # 8876</li><li>• Gas Cylinder Safety Course # 9518</li></ul> <p>B. In addition to the LANL institutional training the following LANSCE facility training must be completed in order to work in 1FP12 at ER2:</p> <ul style="list-style-type: none"><li>• TA-53 Facility Specific Course # 9693</li><li>• TA-53 Building Emergency Plan Course # 26463</li><li>• Limited Access Training – Lujan Course # 21701</li></ul> <p>C. Required reading assignment specific to this OJT is listed in section IV.</p> <p>D. Qualification and line management authorization to perform the work specified by this OJT Lesson Plan will be granted only after</p>	Date	Changed content	July 11, 2006	Original	August 28, 2006	Clarification to training prerequisites, fixed Errors, and cleared text with comments	September 11, 2006	Typos fixed	
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<p>meeting all job-specific, facility and institutional training and qualification requirements.</p> <p><b>II. Key Knowledge Requirements</b></p> <p>Before proceeding with demonstrations, hands on work, and performance evaluation, it is important to ensure that trainees have an overall concept of the target system, understanding of certain key target operations, and overall target safety. The instructor should go through the subsystems and their functions, safety systems, and introduce the target related documents. The instructor should also explain the Junior Operator's responsibilities during shifts.</p> <ul style="list-style-type: none"><li>• The instructor should explain an overall structure of the target system, its operational issues, and main hazards and control measures used to reduce risks:<ul style="list-style-type: none"><li>A. Subsystems of the target and their functions are:<ul style="list-style-type: none"><li>a. H2 supply manifold</li><li>b. Gas handling system</li><li>c. Cryostat</li><li>d. Main hydrogen path</li><li>e. Relief system</li><li>f. Isolation vacuum – vacuum pumps</li><li>g. Instrumentation</li><li>h. Target alarm and warning system</li></ul></li><li>B. Hazards:<ul style="list-style-type: none"><li>a. Hydrogen</li><li>b. Cryogens</li><li>c. Mechanical</li><li>d. Electrical</li><li>e. Pressures</li></ul></li><li>C. Mitigations of the hazards:<ul style="list-style-type: none"><li>a. IWD # 0004962“Operation of the NPDGamma Liquid Hydrogen Target in 1FP12”</li><li>b. Proper design and Q/A and testing</li><li>c. Operating procedures</li><li>d. Careful leak checking of the hydrogen lines</li><li>e. Training</li><li>f. Diagrams and documents</li></ul></li></ul></li></ul>	

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<p style="margin-left: 40px;">i. Gas flows ii. Warning and alarm system</p> <p style="margin-left: 20px;">g. Triple containment of Hydrogen - Helium channels h. Relief valves and rupture disks i. Helium buffer volumes j. Record keeping; logbook k. Configuration management</p> <ul style="list-style-type: none"> <li>• Instructor should review personnel roles and responsibilities. He should describe duties of and functional relationship between Senior and Junior Operators.</li> <li>• Instructor should introduce main target documents.</li> <li>• Instructor should introduce shift personnel, their responsibilities, CCR, EAM, how to respond to ER2 alarms, how to do fire alarm, who should be informed if there is a alarm related to the LH2 target.</li> </ul> <p><b>III. Instructor’s Demonstration</b></p> <p>In this portion of the OJT course, the instructor walks through the listed steps of a target operation process. The trainee and the instructor both follow along in the indicated sections of the Performance Checklist as the demonstration proceeds. The instructor should provide background information to ensure the trainee understands the underlying reasons for the steps that are demonstrated. The instructor should also pose questions and scenarios to check for trainee understanding of various tasks and related sub-tasks.</p> <p><b>IV. REQUIRED READING</b></p> <p>A. IWD # P-25-IWD-06-47.0 Revision#: JHA ID: 00004962“Operation of the NPDGamma Liquid Hydrogen Target in 1FP12” (the most important reading!!)</p> <p>B. NPDGamma Liquid Hydrogen Target Engineering Document</p> <p>C. The NPDGamma Liquid Hydrogen Target User’s Guide</p> <p>D. Flow diagrams for the LH2 target system, target vacuum, gas handling system, manifolds for hydrogen, helium and argon</p> <p>E. The Target Alarm and Warning system diagram</p> <p>F. Procedures for abnormal target situations</p>	<p align="center"><b>Initials Indicate Verification of Required Reading</b></p>

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<p>G. The NPDGamma Liquid Hydrogen Target User’s Guide                      H. Hydrogen Target Safety Review reports</p> <p><b>V. PERFORMANCE CHECKLIST</b></p> <p><b>TASK 1: Find out the status of the target system</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Which pumps are on ?</li> <li><input type="checkbox"/> Which valves are open and closed ?</li> <li><input type="checkbox"/> Temperatures in the target ?</li> <li><input type="checkbox"/> Status of the Warning and Alarm System ?</li> <li><input type="checkbox"/> <i>Question for the trainee:</i> <ul style="list-style-type: none"> <li>○ No electrical power – how to find out the status of the target ?</li> </ul> </li> </ul> <p><b>TASK 2: Replacing an empty hydrogen gas cylinder in manifold</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Familiarize with the section “Replace depleted hydrogen bottles” in the “The NPDGamma Liquid Hydrogen Target User’s Guide”.</li> <li><input type="checkbox"/> Close the proper valves</li> <li><input type="checkbox"/> Remove the empty cylinder</li> <li><input type="checkbox"/> Connect the new cylinder to manifold</li> <li><input type="checkbox"/> Leak check the opened joint</li> <li><input type="checkbox"/> Tag and store the empty cylinder</li> <li><input type="checkbox"/> Make notes to logbook</li> <li><input type="checkbox"/> <i>Question for the trainee:</i> <ul style="list-style-type: none"> <li>○ What can go wrong?                             <ul style="list-style-type: none"> <li>▪ Leak – hydrogen fire</li> <li>▪ Regulator failure</li> <li>▪ Trapped air in lines - fire</li> </ul> </li> </ul> </li> </ul> <p><b>TASK 3: Prepare gas handling system for hydrogen operation</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Familiarize with the section “Evacuation and flushing of the target and filling lines with hydrogen” in the “The NPDGamma Liquid Hydrogen Target User’s Guide”. Study the gas handling system flow diagram.</li> <li><input type="checkbox"/> Check that valves are in proper position</li> <li><input type="checkbox"/> Pump and flush the lines with helium and then with hydrogen</li> <li><input type="checkbox"/> Make notes to logbook</li> <li><input type="checkbox"/> <i>Questions for the trainee:</i> <ul style="list-style-type: none"> <li>○ What can go wrong and what are consequences?</li> </ul> </li> </ul>	<hr/>

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<ul style="list-style-type: none"><li>○ When do you think that you need to perform a thorough leak check?</li></ul> <p><b>TASK 4: Pumping of the isolation vacuum</b></p> <ul style="list-style-type: none"><li>□ Components of a vacuum station and different vacuum gauges</li><li>□ Study the target vacuum system flow diagram</li><li>□ Check the status of the appropriate valves and pressures in isolation vacuum</li><li>□ Turn pumps on and start pumping</li><li>□ Perform vacuum check</li><li>□ Use RGA to find out residual gas content of the isolation vacuum</li><li>□ Make notes to logbook</li><li>□ <i>Question for the trainee:</i><ul style="list-style-type: none"><li>○ How can you damage the turbo pump?</li><li>○ Which residual gas peaks you expect to see in RGA spectrum and why?</li></ul></li></ul> <p><b>TASK 5: Filling and cooling the Target with hydrogen</b></p> <ul style="list-style-type: none"><li>□ Familiarize with the section “Filling and cooling the target with hydrogen” in the “The NPDGamma Liquid Hydrogen Target User’s Guide”.</li><li>□ Study the target vacuum system flow diagram.</li><li>□ Study the gas handling system flow diagram.</li><li>□ Check the status of appropriate valves.</li><li>□ Flush and pump the target with hydrogen if necessary.</li><li>□ Fill target with hydrogen gas and start cooling.</li><li>□ Start precooling system</li><li>□ Set hydrogen supply pressure and flow rate</li><li>□ Follow the supply pressure and pressure in the target</li><li>□ <i>Question for the trainee:</i><ul style="list-style-type: none"><li>○ If one of the two cryo-refrigerators is stopped what to do?</li><li>○ What are possible reasons that cryo-refrigerator fails?</li><li>○ What is time constant in the cooling process?</li><li>○ Explain how the cryo-coolers are connected to the target vessel and to the radiation shield</li><li>○ What to do if the pressure in the target starts to increase?</li><li>○ What pressure will activate a relief valve and rupture</li></ul></li></ul>	

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<p>disk?</p> <ul style="list-style-type: none"> <li>○ Why is it a problem if the pressure in the target is less than 11.2 psia and what should to be done?</li> </ul> <p><b>TASK 7: Abnormal Target Situations</b></p> <ul style="list-style-type: none"> <li>❑ Loss of electrical power – UPS powered alarm system</li> <li>❑ Ice block in the cryostat – in the exhaust line and in the precooling loop</li> <li>❑ Loss of heater – running system with positive pressure</li> <li>❑ Loss of cryocooler</li> <li>❑ Low O2 alarm – clearing alarm</li> <li>❑ Panic button functions – when to use it and what will happen</li> <li>❑ Hydrogen fire</li> <li>❑ <i>Question for the trainee:</i> <ul style="list-style-type: none"> <li>○ What will happen when the battery runs out of power</li> <li>○ What is the best method to prevent ice blockage?</li> <li>○ What to do when cryo cooler is stopped?</li> </ul> </li> </ul> <p>How to do a fire alarm?</p> <p><b>TASK 8: Check the functionality of the Warning and Alarm System</b></p> <ul style="list-style-type: none"> <li>❑ H2 cave monitors – set points and calibration – CCR and ER2 alarm - response</li> <li>❑ H2 monitors in gas panel cabinet – set points and calibration - response</li> <li>❑ He partial pressure in the isolation vacuum</li> <li>❑ Target pressure</li> <li>❑ O2 monitor – set points calibration</li> <li>❑ He channel flow</li> <li>❑ ER2 evacuation alarm</li> <li>❑ By pass the ER2 evacuation alarm</li> <li>❑ How to clear alarms</li> <li>❑ Listen alarm when in cave</li> <li>❑ <i>Question for the trainee:</i> <ul style="list-style-type: none"> <li>○ Which of these signals will have an alarm</li> <li>○ What will take place if we have an alarm</li> <li>○ If you notice that you have a failure in the warning and alarm system, what to do?</li> </ul> </li> </ul> <p><b>VI. Practice Under Supervision</b></p>	

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<p>After completing the demonstration portion of this OJT lesson plan provide the trainee with the opportunity to practice under supervision the target system operations. The trainee should be allowed to ask questions and use the available documentation.</p> <p>When the trainee and the OJT instructor deem appropriate, a trainee performance evaluation should be scheduled.</p> <p><b>VII. Trainee Performance Evaluation</b> The OJT Evaluator should use the above performance checklist (Section V of this Lesson Plan) to assess trainee competence in conducting the Target operations under supervision. As the trainee completes each of the indicated tasks the instructor should check or initial the right hand column of the checklist. During the performance evaluation no assistance should be provided. The point of the evaluation portion of the OJT course is to determine the trainee's readiness to perform the target operations under supervision.</p> <p><b>VIII. Documentation</b> If the trainee completes the performance evaluation according to the procedure and to the satisfaction of the OJT evaluator, this form should be signed and dated below. <i>The original should be forwarded to the P-Division Training Records Specialist for entry into electronic and hard copy worker qualification files.</i> Be sure to include a checked and signed copy of the Performance Checklist that the evaluator used to document observations. If the trainee fails to complete the performance evaluation according to the procedure or to the satisfaction of the OJT evaluator, the performance evaluation should be cancelled. Remedial instruction and additional time for supervised practice should be provided to the trainee. A re-test should be scheduled when the trainee and instructor deem appropriate</p>	

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In signing below the trainee and the OJT trainer verify that the results of this performance evaluation are accurate and the trainee has demonstrated understanding and competence sufficient to performance alone NPDGamma Liquid Hydrogen Target operations in 1FP12 at ER2 at TA-53. Completion of this performance evaluation, the written assessment and other training requirements determines worker qualification.

\_\_\_\_\_  
Trainee (Z# \_\_\_\_\_ )

Date: \_\_\_\_\_

\_\_\_\_\_  
Trainer (Z# \_\_\_\_\_ )

Date: \_\_\_\_\_