





# **Model Curriculum**

**QP Name: Green Hydrogen Storage Hub Senior Operator** 

QP Code: LSC/Q3902

**QP Version: 1.0** 

**NSQF Level: 4** 

Model Curriculum Version: 1.0

Logistics Sector Skill Council || Logistics Sector Skill Council, No. 480 A, 7th floor Khivraj Complex 2, Anna Salai, Nandanam, Chennai, Tamil Nadu 600035





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# **Training Parameters**

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Sector	Logistics
Sub-Sector	Port Terminals, ICD and CFS, Liquid Logistics, Warehousing (Storage & Packaging)
Occupation	Green Hydrogen Operations/Handling, Hub Operations
Country	India
NSQF Level	4
Aligned to NCO/ISCO/ISIC Code	NC0-2015/3133
Minimum Educational Qualification and Experience	<ul> <li>12th grade Pass (Chemistry) with 1 Year of experience in handling DG/ Chemicals</li> <li>OR</li> <li>Completed 2nd year of the 3-year diploma after 10 (in chemical engineering) with 1 Year of experience in handling DG/</li> <li>Chemicals</li> <li>OR</li> <li>10th grade pass (with 2 Years of ITI in relevant field) with 1 Year of experience in handling DG/ Chemicals</li> <li>OR</li> <li>9th grade pass with 4 Years of experience (4.5 Years of relevant experience in handling DG/ Chemicals)</li> <li>OR</li> <li>Previous relevant Qualification of NSQF Level (3) with 3 Years of experience in handling DG/ Chemicals</li> </ul>
Pre-Requisite License or Training	NA
Minimum Job Entry Age	19
Last Reviewed On	30-04-2024
Next Review Date	30-04-2027
NSQC Approval Date	30-04-2024
QP Version	1.0
Model Curriculum Creation Date	15-03-2024
Model Curriculum Valid Up to Date	30-04-2027
Model Curriculum Version	1.0
Minimum Duration of the Course	480
Maximum Duration of the Course	480





# **Program Overview**

This section summarizes the end objectives of the program along with its duration.

### **Training Outcomes**

At the end of the program, the learner will be able to:

## **Compulsory Modules**

The table lists the modules, their duration and mode of delivery.

NOS and Module Details	Theory Duration	Practical Duration	On-the-Job Training Duration (Mandatory)	On-the-Job Training Duration (Recommended)	Total Duration
Bridge Module	20	10			30
<b>Module 1:</b> Introduction to Green Hydrogen storage Hub senior Operator	20	10			30
LSC/N3912 - Assist in installing green hydrogen storage systems V1.0 NSQF Level 4	15	40	5		60
Module 2: Installing green hydrogen storage systems	15	40	5		60
LSC/N3913 - Execute loading and unloading operations V1.0 NSQF Level 4	15	40	5		60
Module 3: Loading and unloading operations of GH2	15	40	5		60
LSC/N3914 - Manage green hydrogen weight distribution V1.0 NSQF Level 4	15	40	5		60
Module 4: Green hydrogen weight distribution	15	40	5		60
LSC/N3915 - Comply with green hydrogen storage parameters V1.0 NSQF Level 4	15	40	5		60
Module 5: Compliance with green hydrogen storage parameters	15	45			60

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LSC/N3916 - Handle cryogenic hydrogen vessels V1.0 NSQF Level 4	15	40	5	60
Module 6: Handling Cryogenic Hydrogen Vessels	15	40	5	60
LSC/N3917 - Coordinate efficient green hydrogen dispatch V1.0 NSQF Level 4	15	40	5	60
Module 7: Dispatching Green Hydrogen	15	40	5	60
LSC/N3918 - Follow health, safety & emergency protocols at green hydrogen storage hubs	15	40	5	60
V1.0 NSQF Level 4				
Module 8: Health, safety & emergency protocols at green hydrogen storage hubs	15	40	5	 60
Employability Skills DGT/VSQ/N0101	15	15		30
Total Duration	140	310	30	480





# **Module Details**

## Module 1: Introduction to Green Hydrogen Storage Hub Senior Operator Mapped to Bridge Module

## **Terminal Outcomes:**

- Describe the Basics of Green Hydrogen
- Brief the applications of green hydrogen in industry, transport and power production.

Duration: 20:00	Duration: 10:00	
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes	
<ul> <li>Describe the properties and characteristics of Hydrogen</li> <li>Discuss various colour code nomenclature of Hydrogen</li> <li>Elaborate the role of Green Hydrogen in sustainable energy transition.</li> <li>Discuss key aspects related to production, storage and transportation of Green Hydrogen</li> <li>Briefly describe the applications of green hydrogen in industry, transport, and power production.</li> <li>Explain the National Green Hydrogen Mission.</li> </ul>	<ul> <li>Demonstrate mapping the name of hydrogen with chart colour code and nomenclature.</li> <li>Perform an activity to match the process and source of production of different colour codes of hydrogen.</li> <li>Draw a flow diagram of the green hydrogen value chain.</li> <li>List down the potential end uses of GH2 across the energy system.</li> <li>Discuss the various bay areas and functions in the GH2 storage hub.</li> <li>Illustrate the role and responsibilities of the Green Hydrogen Storage Hub Senior Operator.</li> </ul>	
Classroom Aids		
Charts, Models, Video presentation, Flip Chart, Whiteboard/Smart Board, Marker, Board eraser		
Tools, Equipment and Other Requirements		
Green Hydrogen colour charts, LLMS(learning version)		





# Module 2: Installing green hydrogen storage systems Mapped to LSC/N3912, v1.0

#### **Terminal Outcomes:**

- Demonstrate the steps for providing refuelling assistance to customers.
- Explain the process of installing compressed hydrogen storage systems.
- Perform supporting activities in installing compressed hydrogen storage systems.
- List and explain the various testing methods for storage tanks, such as Bonfire testing, Hydrostatic burst, Ambient pressure cycling, Penetration, and Leak-before-break tests.

Duration: 15:00	Duration: 40:00
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
<ul> <li>Explain the process of installing compressed hydrogen storage systems.</li> <li>Describe the significance of monitoring the installation of safety relief devices.</li> <li>Detail the checks to be done during visual inspection.</li> <li>List and explain the various testing methods for storage tanks, such as Bonfire testing, Hydrostatic burst, Ambient pressure cycling, Penetration, and Leak- before-break tests.</li> </ul>	<ul> <li>Demonstrate the steps of installing compressed hydrogen storage systems.</li> <li>Illustrate the safety precautions to be followed during the installation.</li> <li>List down the checks to be done during the installation process.</li> <li>Perform supporting activities in installing compressed hydrogen storage systems.</li> <li>Conduct testing of the installed unit.</li> <li>Report any observations or potential issues to the concerned authority for further evaluation and action.</li> </ul>

#### Classroom Aids

Whiteboard, Flip Chart, Markers, Duster, Laptop/Computer with Internet, Projector Screen, Visual aids (PowerPoint Presentations, Videos, diagrams, charts)

#### **Tools, Equipment and Other Requirements**

PPE (safety goggles, gloves, and hearing protection), Layout drawings and installation manuals, Wrenches, screwdrivers, pipe wrenches, adjustable pliers, torque wrenches, Fire extinguishers, first aid kits, emergency eyewash stations, Hoists, cranes, slings, shackles for safe handling of cylinders, High-pressure cylinder restraints and anchoring materials, Permanent markers, adhesive labels, Hydrogen sensors, gas detectors, Pressure gauges, leak detectors, pressure relief device testers, Relief valves, rupture discs, Bonfire testing equipment, hydrostatic testing equipment





# Module 3: Loading and unloading operations of GH2 Mapped to LSC/N3913, v1.0

#### **Terminal Outcomes:**

- Demonstrate the preparation process before loading and unloading of green hydrogen.
- Describe the loading and unloading operations of green hydrogen.
- Identify and troubleshoot operational issues during loading and unloading to minimise downtime.
- Ensure comprehensive documentation of the activities and maintain accurate records.

Duration: 15:00	Duration: 40:00	
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes	
<ul> <li>Explain how to prepare the hub for loading and unloading green hydrogen.</li> <li>Describe the loading and unloading operations of green hydrogen.</li> <li>List down the checks to be done during loading and unloading.</li> <li>Discuss the reporting process and procedure to communicate deviations.</li> </ul>	<ul> <li>Demonstrate the preparation process before loading and unloading of green hydrogen.</li> <li>Monitor weather conditions and suggest alternations to the loading/unloading plans.</li> <li>Perform the steps of loading and unloading operations of green hydrogen.</li> <li>Identify and troubleshoot operational issues during loading and unloading to minimise downtime.</li> <li>Ensure comprehensive documentation of the activities and maintain accurate records.</li> </ul>	
Classroom Aids		
Whiteboard, Flip Chart, Markers, Duster, Laptop/Computer with Internet, Projector Screen, Visual aids (PowerPoint Presentations, Videos, diagrams, charts)		

#### Tools, Equipment and Other Requirements

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Safety gear (safety goggles, gloves, and hearing protection), sample documents (Job sheets, transportation schedules, loading/unloading plans, activity logs, regulations), manuals, Signage and safety protocols, Inspection checklists, Load cells, scales, Weather apps, Radios.





# Module 4: Green hydrogen weight distribution Mapped to LSC/N3914, v1.0

#### **Terminal Outcomes:**

- Detail the process of measuring the weight of stored hydrogen.
- Perform the steps for calculating and verifying the actual weight distribution.
- Conduct post-loading checks and verify final weight distribution.

Duration: 15:00	Duration: 40:00
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
<ul> <li>Detail the process of measuring the weight of stored hydrogen.</li> <li>Explain the formulas and methodologies to calculate the weight distribution across the storage infrastructure.</li> <li>Describe the corrective actions that can be taken to prevent any exceedance of weight.</li> </ul>	<ul> <li>Obtain weight distribution guidelines and review relevance to the storage infrastructure (e.g., pipelines, tanks, platforms, foundations).</li> <li>Compare existing weight distribution with guidelines.</li> <li>Perform the steps for calculating and verifying the actual weight distribution.</li> <li>Adjust the loading sequence for planned weight distribution.</li> <li>Conduct post-loading checks and verify final weight distribution.</li> </ul>
Classroom Aids	

Charts, Models, Video presentation, Flip Chart, Whiteboard/Smart Board, Marker, Board eraser **Tools, Equipment and Other Requirements** 

Personal Protective Equipment (safety goggles, gloves, and hearing protection), Weight distribution guidelines documentation, Inventory records, equipment manuals, measurement tools (e.g., scales, load cells), Calibration tools for weight measurement instruments, Weight distribution variables documentation (e.g., hydrogen quantity, equipment weight), Post-loading checklists, Radios, phones, templates for activity logs, reports, Safety posters or signage





# Module 5: Compliance with green hydrogen storage parameters Mapped to LSC/N3915, v1.0

#### **Terminal Outcomes:**

- Describe the process of maintaining GH2 optimal storage conditions.
- Perform the steps in handling Compressed Gaseous Hydrogen (CGH2) pressure vessels.
- Elaborate the methods of conducting leak tests.

Duration: 15:00	Duration: 45:00
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
<ul> <li>Detail the methods for maintaining optimal storage conditions for GH2.</li> <li>Explain the key storage parameters, KPIs and safety regulations for storing GH2.</li> <li>Describe the parameters and steps for handling Compressed Gaseous Hydrogen (CGH2) pressure vessels.</li> <li>Elaborate the methods of conducting leak tests.</li> </ul>	<ul> <li>Describe the process of maintaining GH2 optimal storage conditions.</li> <li>Set and monitor inventory capacity limits to avoid overfilling and potential safety hazards.</li> <li>Implement relevant regulations and standards for green hydrogen storage facilities (e.g., NFPA 2, ISO 14687, local regulations).</li> <li>Perform the steps in handling Compressed Gaseous Hydrogen (CGH2) pressure vessels.</li> <li>Illustrate the procedure for operating and maintaining the green hydrogen storage units.</li> <li>Inspect the storage facilities as per the storage parameters, KPIs and safety regulations.</li> <li>Prepare and submit required reports to relevant authorities as per stipulated deadlines.</li> </ul>
Classroom Aids	
Charts, Models, Video presentation, Flip Chart,	, Whiteboard/Smart Board, Marker. Board

Charts, Models, Video presentation, Flip Chart, Whiteboard/Smart Board, Marker, Board eraser

#### Tools, Equipment and Other Requirements

Personal Protective Equipment (safety goggles, gloves, and hearing protection), Weight distribution guidelines documentation, Inventory records, equipment manuals, measurement tools (e.g., scales, load cells), Calibration tools for weight measurement instruments, Weight distribution variables documentation (e.g., hydrogen quantity, equipment weight), Post-loading checklists, Radios, phones, templates for activity logs, reports, Safety posters or signage.





# Module 6: Handling cryogenic hydrogen vessels Mapped to LSC/N3916, v1.0

#### **Terminal Outcomes:**

CcH2 vessels

- Demonstrate the steps involved in managing the storage of cryogenic vessels for LH2 and CcH2.
- Describe boil-off losses with prevention methods.
- Inspect the vessels as per the parameters and using leak detection systems.

Duration: 15:00	Duration: 40:00	
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes	
<ul> <li>Detail about cryogenic vessels and their safety protocols.</li> <li>Explain the characteristics of LH2 (Liquid dihydrogen) and CcH2 (Cryo-compressed Hydrogen).</li> <li>Describe boil-off losses with prevention methods.</li> <li>Discuss the pressure vessel regulations and temperature limits for cryogenic vessels.</li> </ul>	<ul> <li>Safely store and handle LH2 in dedicated insulated tanks, ensuring proper ventilation and adherence to safety distances.</li> <li>Demonstrate the steps involved in managing the storage of cryogenic vessels for LH2 and CcH2.</li> <li>Illustrate the safety protocols and handling instructions for cryogenic vessels.</li> <li>Inspect the vessels as per the parameters and using leak detection systems.</li> </ul>	
Classroom Aids		
Charts, Models, Video presentation, Flip Chart, Whiteboard/Smart Board, Marker, Board eraser		
Tools, Equipment and Other Requirements		
Personal Protective Equipment (cryogenic gloves, face shields, and insulated clothing), Cryogenic safety protocols documentation (e.g., manuals, standards), LH2 and CcH2 vessel operation manuals, Inspection checklists for LH2 and CcH2 vessels, Leak detection systems for CcH2 vessels, Grounding equipment for LH2 handling, Regulatory documentation for		

cryogenic hydrogen handling, Radios, phones, Safety posters or signage, Sample LH2 and





# Module 7: Dispatching Green Hydrogen Mapped to LSC/N3917, v1.0

#### **Terminal Outcomes:**

- Describe the dispatching process of green hydrogen.
- Demonstrate the activities for executing GH2 dispatch.
- Explain the safety regulations and procedures for different types of hydrogen transportation.

Duration: 15:00	Duration: 40:00	
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes	
<ul> <li>Describe the dispatching process of green hydrogen.</li> <li>Detail the resources required for efficient GH2 dispatch.</li> <li>Discuss the procedure involved in dispatch execution.</li> <li>Explain the safety regulations and procedures for different types of hydrogen transportation.</li> </ul>	<ul> <li>Assess the compatibility of green hydrogen grade with transportation mode, evaluate potential hazards based on route and weather conditions, and ensure compliance with safety regulations.</li> <li>Perform the steps involved in scheduling the GH2 dispatch.</li> <li>Implement dispatch plans that optimise resource utilisation, minimise costs, and meet delivery requirements.</li> <li>Demonstrate the activities for executing GH2 dispatch.</li> <li>Implement contingency plans to address disruptions and minimise impact on deliveries.</li> </ul>	
Classroom Aids		
Charts, Models, Video presentation, Flip Chart, Whiteboard/Smart Board, Marker, Board eraser		
Tools, Equipment and Other Requirements		
Personal Protective Equipment (safety vests, hard hats, and steel-toed boots), Inventory tracking		

Personal Protective Equipment (safety vests, hard hats, and steel-toed boots), Inventory tracking systems, Dispatch plan documentation, Radios, phones, email systems, Contingency plan documentation, Dispatch record templates, Sample dispatch plans, and Compliance documentation.





# Module 8: Health, safety & emergency Protocols at green hydrogen storage hubs

## Mapped to LSC/N3918, v1.0

#### **Terminal Outcomes:**

- Detail the steps involved in maintaining the equipment performance.
- Illustrate the Regulations and Standards levied for handling GH2.
- Comply with the Regulations and Standards for Handling Green Hydrogen.
- Respond promptly and effectively to emergencies and potential hydrogen leaks, including evacuation procedures, communication with emergency services, and implementation of emergency response plans

Charts, Models, Video presentation, Flip Chart, Whiteboard/Smart Board, Marker, Board eraser

#### **Tools, Equipment and Other Requirements**

Pressure gauges, Flow meters, Temperature sensors, Lubricants, filters, Personal protective equipment (flame-resistant suits, goggles, face shields, neoprene or nitrile gloves, safety boots, respirators, and hearing protection), Cryogenic protective clothing and gloves, Hydrogen flame detectors (UV, IR, multi-spectrum, video image), Oil-free equipment, intrinsically safe tools, First-aid kit, Fire extinguishers, Fire hoses, LLMS(learning version)





## Module 6: Employability Skills Mapped to DGT/VSQ/N0101, v1.0

#### **Terminal Outcomes:**

- Appraise the significance of employability skills in meeting the job requirements
- Identify constitutional values, civic rights, duties, personal values and ethics and environmentally sustainable practices.
- Illustrate English and communication skills, customer service, entrepreneurship, and getting ready for jobs and apprenticeship.

Computer (PC) with latest configurations – and Internet connection with standard operating system and standard word processor and worksheet software (Licensed) (all software should either be latest version or one/two version below), Scanner cum Printer.





# Annexure

# **Trainer Requirements**

Trainer Prerequisites						
Minimum Educational	Specialization	Relevant Industry Experience		Training Experience		Remarks
Qualification		Years	Specialization	Years	Specialization	
Any Degree	Handling DG/ Chemicals	2	Handling DG/ Chemicals			

Trainer Certification				
Domain Certification	Platform Certification			
Certified for Job Role: "Green Hydrogen Storage Hub Senior Operator" mapped to QP: "LSC/Q3902, v1.0". Minimum accepted score is 80%	Recommended that the Trainer is certified for the Job Role: "Trainer (VET and Skills)", mapped to the Qualification Pack: "MEP/Q2601, V2.0". Minimum accepted score is 80%			





# **Assessor Requirements**

Assessor Prerequisites						
Educational	Specialization	Relevant Industry Experience		Training/Assessment Experience		Remarks
Qualification		Years	Specialization	Years	Specialization	
Any Degree	Handling DG/ Chemicals	2	Handling DG/ Chemicals			

Assessor Certification				
Domain Certification	Platform Certification			
Certified for Job Role: "Green Hydrogen Storage Hub Senior Operator" mapped to QP: "LSC/Q3902, v1.0". Minimum accepted score is 80%	Recommended that the Assessor is certified for the Job Role: "Assessor (VET and Skills)", mapped to the Qualification Pack: "MEP/Q2701, V2.0" with Minimum score of 80%			





## **Assessment Strategy**

The emphasis is on 'learning-by-doing' and practical demonstration of skills and knowledge based on the performance criteria. Accordingly, assessment criteria for each job role is set and made available in qualification pack.

The assessment papers for both theory and practical would be developed by Subject Matter Experts (SME) hired by Logistics Sector Skill Council or with the LSC accredited Assessment Agency as per the assessment criteria mentioned in the Qualification Pack. The assessments papers would also be checked for the various outcome-based parameters such as quality, time taken, precision, tools & equipment requirement etc.

Each NOS in the Qualification Pack (QP) is assigned a relative weightage for assessment based on the criticality of the NOS. Therein each Element/Performance Criteria in the NOS is assigned marks on relative importance, criticality of function and training infrastructure.

The following tools would be used for final assessment:

1. **Practical Assessment:** This comprises of a creation of mock environment in the skill lab which is equipped with all equipment required for the qualification pack.

Candidate's soft skills, communication, aptitude, safety consciousness, quality consciousness etc. is ascertained by observation and marked in observation checklist. The outcome is measured against the specified dimensions and standards to gauge the level of their skill achievements.

- 2. **Viva/Structured Interview:** This tool is used to assess the conceptual understanding and the behavioral aspects with regard to the job role and the specific task at hand. It also includes questions on safety, quality, environment and equipment etc.
- 3. **On-Job Training:** OJT would be evaluated based on standard log book capturing departments worked on, key observations of learner, feedback and remarks of supervisor ormentor.
- 4. Written Test: Question paper consisting of 100 MCQs (Hard:40, Medium:30 and Easy: 30) with questions from each element of each NOS. The written assessment paper is comprised of following types of questions:
  - i. True / False Statements
  - ii. Multiple Choice Questions
  - iii. Matching Type Questions
  - iv. Fill in the blanks
  - v. Scenario based Questions
  - vi. Identification Questions





## **QA Regarding Assessors:**

Assessors are selected as per the "eligibility criteria" laid down by LSC for assessing each job role. The assessors selected by Assessment Agencies are scrutinized and made to undergo training and introduction to LSC Assessment Framework, competency based assessments, assessors guide etc. LSC conducts "Training of Assessors" program from time to time for each job role and sensitize assessors regarding assessment process and strategy which is outlined on following mandatory parameters:

- 1) Guidance regarding NSQF
- 2) Qualification Pack Structure
- 3) Guidance for the assessor to conduct theory, practical and viva assessments
- 4) Guidance for trainees to be given by assessor before the start of the assessments.
- 5) Guidance on assessments process, practical brief with steps of operations practical observation checklist and mark sheet
- 6) Viva guidance for uniformity and consistency across the batch.
- 7) Mock assessments
- 8) Sample question paper and practical demonstration



# References



# Glossary

Term	Description
Key Learning Outcome	Key learning outcome is the statement of what a learner needs to know, understand and be able to do in order to achieve the terminal outcomes. A set of key learning outcomes will make up the training outcomes. Training outcome is specified in terms of knowledge, understanding (theory) and skills (practical application).
Training Outcome	Training outcome is a statement of what a learner will know, understand and be able to do upon the completion of the training.
Terminal Outcome	Terminal outcome is a statement of what a learner will know, understand and be able to do upon the completion of a module. A set of terminal outcomes help to achieve the training outcome.





# Acronyms and Abbreviations

Term	Description
QP	Qualification Pack
NSQF	National Skills Qualification Framework
NSQC	National Skills Qualification Committee
NOS	National Occupational Standards