QUALIFICATION FILE– Micro Credentials

Basics of Green Hydrogen Cooling and Compression Process

☒Public ☐ Private

☒ Upskilling ☐ Dual/Flexi Qualification ☐ For ToT ☐ For ToA

☐ General ☐ Multi-skill (MS) ☐ Cross Sectoral (CS) ☒ Future Skills ☐ OEM

NCrF/NSQF Level: 5

Submitted By:

Hydrocarbon Sector Skill Council

Chief Executive Officer

OIDB Bhawan, Block G+3, 2nd Floor,

Plot No.2, Vikas Marg, Sector – 73,

Noida, Uttar Pradesh -201301

Contact Details: +91 9871115360;

Email id: ceo@hsscindia.in

Table of Contents

Section 1: Basic Details

<table>
<tr><td>1.</td><td>Micro Credential-Qualification Name</td><td colspan="2">Basics of Green Hydrogen Cooling and Compression Process</td></tr>
<tr><td>2.</td><td>Sector/s</td><td colspan="2">Hydrocarbon</td></tr>
<tr><td>3.</td><td>National Qualification Register (NQR) Code & Version
(Will be issued after NSQC approval)</td><td>NM-05-HY-02999-2024-V1-HSSCI</td><td>4. NCrF/NSQF Level: 5</td></tr>
<tr><td>5.</td><td>Brief Description of the Qualification</td><td colspan="2">Green Hydrogen cooling and compression technician is responsible for operating hydrogen compressor systems in a green hydrogen generation facility in a safe, reliable and efficient manner. The role will include but not be limited to performing routine operating, maintenance, troubleshooting, and repairs. The individual will be accountable for ensuring that the facility maintains a safe and healthy work environment, besides maintaining production logs and other documentation.</td></tr>
<tr><td>6.</td><td>Eligibility Criteria for Entry for Student/Trainee/Learner/Employee</td><td colspan="2">a. Entry Qualification & Relevant Experience:
<table>
<tr><th>S. No.</th><th>Academic/Skill Qualification (with Specialization - if applicable)</th><th>Required Experience (with Specialization - if applicable)</th></tr>
<tr><td>1</td><td>Completed 3-year diploma after 10th (Engineering)</td><td>with 1.5 year of relevant experience</td></tr>
<tr><td>2</td><td>Completed 12th or equivalent in science</td><td>3 years of relevant experience</td></tr>
</table>
b. Age: 22</td></tr>
<tr><td>7.</td><td>Credits Assigned to this Qualification, Subject to Assessment (as per National Credit Framework (NCrF))</td><td>1</td><td>8. Common Cost Norm Category – Category (I)</td></tr>
<tr><td>9.</td><td>Any Licensing requirements for Undertaking Training on This Qualification (wherever applicable)</td><td colspan="2">NA</td></tr>
<tr><td>10.</td><td>Expected Outcomes of the Micro Credential</td><td colspan="2">Terminal learning outcomes are:
• Understand Green hydrogen production pathways and purification
• Understand Hydrogen compression, storage and transportation
• Applications of Hydrogen
• Introduction about cooling and compression phenomenon
• Different Types of compressors: Positive displacement (Rotary and Reciprocating) and Dynamic (Centrifugal and Axial),
• Hermetically sealed, open, or semi-hermetic compressors for zero leak
• Other components of a compressor-staged compressions, drive motors, lubricants, etc</td></tr>
</table>

		• Generic applications of compressors • Basics about hydrogen cooling and liquification • Different types of mechanical and non-mechanical compressors used for hydrogen compression on industrial scale • Different types of storage systems for cryo/liquid-hydrogen and compressed hydrogen • Sources of impurities during compression and storage stages • Common Faults and Analysis of Hydrogen Compressor • Safety issues and various applicable standards • Expected roles of responsibilities of a production technician handling cooling & compression unit in a green hydrogen generation facility
11.	**Training Duration by Modes of Training Delivery** *(Specify **Total Duration** as per selected training delivery modes and as per requirement of the qualification)*	**☒Offline ☐Online ☐Blended** **Training Delivery Modes** / **Theory (Hours)** / **Practical (Hours)** / **OJT Mandatory (Hours)** / **OJT Recommended (Hours)** / **Total (Hours)** **Classroom (offline)**: 20 / 10 / - / - / 30 **Online**: / / / / / *(Refer Blended Learning Annexure for details)*
12.	**Assessment Criteria**	**Theory (Marks)**: 275 / **Practical (Marks)**: 164 / **Project (Marks)**: 0 / **Viva (Marks)**: 0 / **Total (Marks)**: 439 / **Passing %age**: 70
13.	**Other Indian languages in which the Micro Credential will be implemented**	**Hindi**
14.	**Is similar Micro Credentials Qualification(s) available on NQR-if yes, justification for this qualification**	**☐ Yes ☒ No**
15.	**Is the Job Role Amenable to Persons with Disability**	**☐ Yes ☒ No** **If "Yes", specify applicable type of Disability:**
16.	**How Participation of Women will be Encouraged**	This job is gender neutral and focus during training should be on enrolment of women in each batch. SSC will encourage the TP and other training bodies to enrol women candidates.
17.	**Name and Contact Details of Submitting / Awarding Body SPOC** *(In case of CS or MS, provide details of both Lead AB & Supporting ABs)*	**Name: Mr. SK Bose** **Email: ceo@hsscindia.in** **Contact No.: +91 9871115360** **Website: www.hsscindia.in**
18.	**Final Approval Date by NSQC:** ***27/08/2024***	**19. Validity Duration:** Three Years from the date of Approval **20. Next Review Date:** ***26/08/2027***

Section 2: Training Related

1.	**Trainer's Qualification and experience in the relevant sector (in years)** *(as per NCVET guidelines)*	Post Graduate Electrical/Mechanical/Chemistry with 3 years of Relevant experience & 2 years of training experience
2.	**Master Trainer's Qualification and experience in the relevant sector (in years)** *(as per NCVET guidelines)*	Post Graduate Electrical/Mechanical/Chemistry with 3 years of Relevant experience & 3 years of training experience
3.	**Tools and Equipment Required for Training**	☒Yes ☐No (*If "Yes", details to be provided in Annexure)*
4.	**In Case of Revised Qualification, Details of Any Upskilling Required for Trainer**	NA

Section 3: Assessment Related

	Assessor's Qualification and experience in relevant sector (in years) *(as per NCVET guidelines)*	Post Graduate Electrical/Mechanical/Chemistry with 3 years of Relevant experience & 2 years of training experience
	Proctor's Qualification and experience in relevant sector (in years) *(as per NCVET guidelines)*	Post Graduate Electrical/Mechanical/Chemistry with 3 years of Relevant experience & 2 years of training experience
	Lead Assessor's/Proctor's Qualification and experience in relevant sector (in years) *(as per NCVET guidelines)*	Post Graduate Electrical/Mechanical/Chemistry with 3 years of Relevant experience & 3 years of training experience
	Assessment Mode *(Specify the assessment mode)*	Both – Online and Offline
	Tools and Equipment Required for Assessment	☒ Same as for training ☒ Yes ☐ No *(details to be provided in Annexure-if it is different for Assessment)*

Section 4: Evidence of the need for the Qualification

Provide Annexure/Supporting documents name.

1.	**Latest Skill Gap Study (not older than 2 years) (Yes/No):** Yes
2.	**Latest Market Research Reports or any other source (not older than 2 years) (Yes/No):** Yes
3.	**Government /Industry initiatives/ requirement (Yes/No):** Yes
4.	**Number of Industry validation provided:** 10 (Due to limited number of Industries available in Oil & Gas Sector; endorsed by MoPNG through Letter)
5.	**Estimated nos. of persons to be trained and employed:** Up to 5 lakhs new jobs are expected to be created by 2030 across the Green Hydrogen value chain as per the Green Hydrogen Mission. Multiple qualifications across the key segments of the green hydrogen value chain shall be developed as per the requirement of the industry. It is expected that up to 2000 shall be trained and gradually employed across new projects every year. Green hydrogen generation units in the country as recently announced are mainly under planning stage, targeted skilling activities can be undertaken for priority job roles. Over 4 lakhs jobs are expected to be generated only for meeting the required renewable energy capacity of 125 GW which would be required for powering the Green Hydrogen facilities producing at least 5 MT per annum till 2030. In the medium to long term, innovative business models particularly in transport and power sectors will evolve in the coming decade leading to new opportunities for both jobs and self- employment across various industry clusters. Oil refineries using hydrogen for desulphurization, ammonia production for fertilizers and chemicals industry,

	treatment of basic metals along with steel industry will create the leading market, skilling and employment opportunities for green hydrogen in the short-medium term. Green hydrogen technologies and applications as alternate energy carrier / vector for industrial process heating, transportation and long duration energy storage will also emerge in the long term possibly creating new opportunities for both skilling and employment.
6.	**Evidence of Concurrence/Consultation with Line Ministry/State Departments:** *The Ministry of Petroleum & Natural Gas (MoPNG) which is the Line Ministry for Hydrocarbon Sector has been requested to accord the concurrence* If "No", why:

Section 6: Annexure & Supporting Documents Check List

Specify Annexure Name / Supporting document file name

1.	**Annexure:** NCrF/NSQF level justification based on NCrF level/NSQF descriptors *(Mandatory)*	**Annexure:** NCrF/NSQF level justification based on NCrF level/NSQF descriptors
2.	**Annexure:** List of tools and equipment relevant for qualification *(Mandatory, except in case of online course)*	**Annexure:** List of tools and equipment relevant for qualification
3.	**Annexure:** Detailed Assessment Criteria *(Mandatory)*	**Annexure:** Detailed Assessment Criteria
4.	**Annexure:** Assessment Strategy *(Mandatory)*	**Annexure:** Assessment Strategy
5.	**Annexure:** Blended Learning *(Mandatory, in case selected Mode of delivery is "Blended Learning")*	**Annexure:** Offline Learning Mode
6.	**Annexure:** Multiple Entry-Exit Details *(Mandatory, in case qualification has multiple Entry-Exit)*	**Annexure:** NA
7.	**Annexure:** Acronym and Glossary *(Optional)*	**Annexure:** Acronym and Glossary
8.	**Supporting Document:** Model Curriculum *(Mandatory – Public view)*	**Supporting Document:** Model Curriculum
9.	**Supporting Document:** Career Progression *(Mandatory - Public view)*	**Supporting Document:** Career Progression – Occupational Map
10.	**Supporting Document:** Occupational Map *(Mandatory)*	**Supporting Document:** Occupational Map
11.	**Supporting Document:** Assessment SOP *(Mandatory)*	**Supporting Document:** Assessment SOP
12.	**Any other document you wish to submit:**	**Any other document you wish to submit: NA**

Annexure: Evidence of Level

NCrF/NSQF Level Descriptors	Key requirements of the job role/ outcome of the qualification	How the job role/ outcomes relate to the NCrF/NSQF level descriptor	NCrF/ NSQF Level
Professional Theoretical Knowledge/Process	A Green Hydrogen Production specializing in cooling and compression should possess a strong theoretical foundation in thermodynamics, heat transfer, fluid mechanics, and mechanical engineering principles. Additionally, knowledge of hydrogen production processes, electrolysis, and compression technologies is crucial. Proficiency in safety protocols,	• Possesses specialized knowledge of procedures employed in both routine and non-routine contexts. • Possesses specialized operational knowledge and understanding of the work • Has knowledge of collecting and interpreting the available	5

	instrumentation, and control systems is also essential for ensuring efficient and reliable operation in the production of green hydrogen.	information, drawing conclusions & communicating the same.	
Professional and Technical Skills/ Expertise/ Professional Knowledge	A Green Hydrogen Production focused on cooling and compression needs a blend of professional and technical skills. Proficiency in operating and maintaining cooling systems, compressors, and associated equipment is crucial. Technical skills include expertise in instrumentation, control systems, and troubleshooting. The ability to monitor and optimize process parameters, ensuring safety and efficiency, is essential. Strong problem-solving skills, attention to detail, and a commitment to quality control are also necessary. Additionally, effective communication and collaboration skills are vital for working within a team and coordinating activities in a green hydrogen production facility.	• Possesses specialized professional and technical skills; displays clarity of professional knowledge and technical skills in broad range of activities/ tasks. • Can apply the required knowledge for successfully implementing or applying techniques/ processes in a specific field/ job role • The ability to gain, and where relevant apply a range of knowledge, skills and understanding • Possesses the required operational skills for the work/ job. Skill to deliver job/ work with the required precision and in the estimated timelines. • Capabilities of carrying out a choice of processes and procedures within the range of familiar / unfamiliar contexts.	5
Employment Readiness & Entrepreneurship Skills & Mind-set/Professional Skill	A Green Hydrogen Production with a focus on cooling and compression should possess strong adaptability, critical thinking, and problem-solving skills. Entrepreneurial qualities such as initiative, resourcefulness, and a proactive mindset are essential for optimizing processes and identifying opportunities for efficiency improvements. Effective communication, teamwork, and a commitment to continuous learning contribute to a well-rounded professional prepared for success in the dynamic field of green hydrogen production.	• Have much broader Employability Skills including understanding of career planning, digital skills, financial and legal literacy. • Good Communication skills, both oral and written. • Advanced literacy and Numeracy skills • Can comfortably use most of the basic digital tools, has clear understanding of Financial and Digital literacy, Aadhaar and Mobile, uses digital payments etc. with proficiency • Good understanding of Constitutional values & Citizenship, inclusion and Diversity. • Very Good understanding of social political and work environment	5
Broad Learning Outcomes/Core Skill	A Green Hydrogen Production specializing in cooling and compression includes comprehensive knowledge of hydrogen production processes, expertise in operating and maintaining cooling and compression systems, and proficiency in safety protocols. This professional should demonstrate adaptability, problem-solving skills, and the ability to collaborate within a team. Continuous learning and staying abreast of advancements in green hydrogen technologies are also essential for success in this role.	• The candidate must be able to carry out a specialized job/ work/ tasks in a familiar/ unfamiliar, predictable/ unpredictable, routine/ nonroutine, situation of multiple options/ choices • Focus on range of application of standard procedures or operations in production/services. • Able to identify/ anticipate the problems and possible range of solutions in production/services • Complex tasks are performed by himself without much instructions and supervision.	5

		• Apply related occupational safety & general hygiene norms and environmental aspects. • Applies range of well - developed technical skills with clarity of activities involving clear choices within familiar contexts. • Has knowledge and is able to continuously improve processes which the individual uses for concerned job roles • Has information of associated Risks with related job roles.	
Responsibility	A Green Hydrogen Production specializing in cooling and compression involve operating, monitoring, and maintaining equipment related to hydrogen production. This includes overseeing cooling systems, compressors, and associated machinery to ensure optimal efficiency. The technician must adhere to safety protocols, conduct regular inspections, troubleshoot issues, and collaborate with team members for smooth production processes. Additionally, documenting and reporting operational data and participating in continuous improvement initiatives are key aspects of the role.	The individual is majorly responsible for his own job and self-learning process which justifies the pegging of the QP at level 5 • Can perform all non-standard procedures and non-routine tasks with confidence.	5

Annexure: Tools and Equipment (Lab Set-Up)

List of Tools and Equipment

Batch Size: 30

S. No.	Tool / Equipment Name	Specification	Quantity for specified Batch size
1	• **Shell-and-Tube Heat Exchangers** • **Plate Heat Exchangers** • **Cooling Tower Units** • **Water Chillers** • **Radiators** • **Fans and Blowers** • **Reciprocating Compressors** • **Diaphragm Compressors** • **Screw Compressors** • **Centrifugal Compressors** • **Intercoolers** • **Aftercoolers** • **Gas Pressure Regulators**		NA

	• **High-Pressure Hydrogen Storage Tanks** • **Gas Dryers** • **Check Valves and Safety Valves** • **Pipelines and Fittings** • **Gas Analyzers** • **Pressure Control Systems** • **Automation Systems** • **Emergency Stop Buttons** • **Safety Interlocks** • **Personal Protective Equipment (PPE)** • **Gas Detection Systems** • **Logbooks** • **Data Logging Systems**		
2	**Personal Protective Equipment (PPE):** Safety helmet, safety glasses, ear protection, respiratory protection (if required), protective gloves, safety boots.		NA

Classroom Aids

The aids required to conduct sessions in the classroom are:

1. White / Black board and Projector
2. Digital Presentation
3. Computer/Laptop
4. Public Addressing System

Annexure: Industry Validations Summary*

Provide the summary information of all the industry validations in table. This is not required for OEM qualifications.

S. No	Organization Name	Representative Name	Designation	Contact Address	Contact Phone No	E-mail ID	LinkedIn Profile *(if available)*
1	O.I.L	Shri Jayant Barua	CEO		9435348638	jayantbarua@oilindia.in	
2	BPCL	Shri Vishwas Saxena	Dy. General Manager		9669320555	vishwassaxena@bharatpetroleum.in	
3	HPCL	Imtiyaz Arshad	CEO & Secretary		8332864450	iarshad@hpcl.in	
4	IOCL	Apurva Nagmote	DGM (Learning & Skill Development)		8373919522	nagmoteas@indianoil.in	
5	GAIL	Shri M. A. Qureshi	CM (Training)		9179061305	maqureshi@gail.co.in	
6	CPCL	Shri Ayyamuthu A	Assistant Manager (Personnel)		9732492888	ayyamuthu@cpcl.co.in	
7	CHT	Shri Kishore Kumar Bhimwal	Additional Director		9958798282	kishore.bhimwal@cht.gov.in	
8	MRPL	Shri Venkateswarlu Kumbha	Chief Manager (TS)		9035044404	venkat_kumbha@mrpl.co.in	
9	SOM Projects PVT. LTD.	Shri Kuldeep Kumar	Manager			spplusar@gmail.com	
10	EIL	Shri Tathagat Sahoo	SR Manager HR		9702088305	tathagat.sahoo@eil.co.in	

Annexure: Training & Employment Details

Training and Employment Projections: 1350

Year	Total Candidates		Women		People with Disability	
	Estimated Training #	Estimated Employment Opportunities	Estimated Training #	Estimated Employment Opportunities	Estimated Training #	Estimated Employment Opportunities
2024	350	Green Hydrogen is new in India, so training is given to develop future workforce. Training will be given tom college students	150	Green Hydrogen is new in India, so training is given to develop future workforce. Training will be given tom college students	20	Green Hydrogen is new in India, so training is given to develop future workforce. Training will be given tom college students
2025	450	Green Hydrogen is new in India, so training is given to develop future workforce. Training will be given tom college students	200	Green Hydrogen is new in India, so training is given to develop future workforce. Training will be given tom college students	20	Green Hydrogen is new in India, so training is given to develop future workforce. Training will be given tom college students
2026	550	Green Hydrogen is new in India, so training is given to develop future workforce. Training will be given tom college students	250	Green Hydrogen is new in India, so training is given to develop future workforce. Training will be given tom college students	20	Green Hydrogen is new in India, so training is given to develop future workforce. Training will be given tom college students

Data to be provided year-wise for next 3 years

Annexure: Blended Learning

Blended Learning Estimated Ratio & Recommended Tools:

Refer NCVET "Guidelines for Blended Learning for Vocational Education, Training & Skilling" available on:

https://ncvet.gov.in/sites/default/files/Guidelines%20for%20Blended%20Learning%20for%20Vocational%20Education,%20Training%20&%20Skilling.pdf

S. No.	Select the Components of the Qualification	List Recommended Tools – for all Selected Components	Offline : Online Ratio
1	☐Theory/ Lectures - Imparting theoretical and conceptual knowledge		Offline
2	☐Imparting Soft Skills, Life Skills, and Employability Skills /Mentorship to Learners		Offline
3	☐Showing Practical Demonstrations to the learners		Offline

4	☐Imparting Practical Hands-on Skills/ Lab Work/ workshop/ shop floor training		Offline
5	☐Tutorials/ Assignments/ Drill/ Practice		Offline
6	☐Proctored Monitoring/ Assessment/ Evaluation/ Examinations		Offline
7	☐On the Job Training (OJT)/ Project Work Internship/ Apprenticeship Training		Offline

Annexure: Detailed Assessment Criteria

Detailed assessment criteria for each NOS/Module are as follows:

NOS/Module Name	Assessment Criteria for Performance Criteria/Learning Outcomes		Theory Marks	Practical Marks	Project Marks	Viva Marks
Overview of hydrogen as an energy carrier and Green Hydrogen Value Chain	*Understanding Hydrogen molecule as an energy carrier*		**14**	**7**		
	PC1.	Understand hydrogen molecule	2	1		
	PC2.	Know basic physical properties of hydrogen	2	1		
	PC3.	Know basic chemical properties of hydrogen	2	1		
	PC4.	Workout the basis of energy content of different molecules including hydrogen	2	1		
	PC5.	Identify advantages & disadvantages of hydrogen	2	1		
	PC6.	Know demand supply scenario	2	1		
	PC7.	Comprehend emissions from usage of different energy sources Vs hydrogen	2	1		
	Green hydrogen production pathways and purification		**14**	**7**		
	PC8.	Know hydrogen production using conventional routes	2	1		
	PC9.	Understand green hydrogen production using renewable energy sources like solar & wind	2	1		
	PC10.	Identify and know different types of electrolysers	2	1		
	PC11.	Understand green hydrogen production from biomass gasification	2	1		
	PC12.	Know purification requirements of hydrogen	2	1		
	PC13.	Comprehend emisisons from different hydrogen production methods	2	1		
	PC14.	Understand basis for different colours of hydrogen	2	1		
	Hydrogen compression, storage and transportation		**10**	**5**		
	PC15.	Know the need for hydrogen compression	2	1		
	PC16.	Understand physical storage of hydrogen in cylinders and vessels	2	1		
	PC17.	Know why different types of storage cylinders are required	2	1		

	PC18. Understand chemical storage of hydrogen	2	1		
	PC19. Know how hydrogen is transported in different ways	2	1		
	Applications of Hydrogen	**10**	**5**		
	PC20. Know hydrogen applications and quality requirements.	2	1		
	PC21. Understand application of hydrogen as a blend with CNG	2	1		
	PC22. know application of hydrogen in Fuel Cell	2	1		
	PC23. Observe application of hydrogen in direct IC engine	2	1		
	PC24. List down application of hydrogen in different industries	2	1		
	Total Marks	**48**	**24**		
Concepts about compression phenomenon	PC1. Understand basics of gas cooling and liquification	3	2		
	PC2. Know different methods employed for gas liquification	3	2		
	PC3. Comprehend basic fundamentals of compression phenomenon	3	2		
	PC4. Follow difference between a compressor and a pump	3	2		
	PC5. Identify essential components in a compressor	3	2		
	PC6. Understand different types of compressors	3	2		
	PC7. Know working & differences between Positive Displacement and Dynamic compressors	3	2		
	PC8. Figure out differences between Rotary compressor and reciprocating compressors	3	2		
	PC9. Perform operation of Rotary-Lobe compressors	3	2		
	PC10. Know working of Rotary-Screw compressor	3	2		
	PC11. Know working of Rotary-Liquid ring compressor	3	2		
	PC12. Know working of Rotary-Scroll compressor	3	2		
	PC13. Know working of Rotary-Vane compressor	3	2		
	PC14. Know working of Reciprocating-diaphragm compressor	3	2		
	PC15. Know working of a Reciprocating-double acting compressor	3	2		
	PC16. Know working of a Reciprocating-single acting compressor	3	2		
	PC17. Know working of a Dynamic-centrifugal compressor	3	2		
	PC18. Know working of a working of Dynamic-axial compressor	3	2		
	PC19. Identify and rectify leakage in a compressor	3	2		
	PC20. Identify Hermetically sealed, open, or semi-hermetic compressors	3	2		
	PC21. Follow basic thermodynamics of a compression process	3	2		
	PC22. Know various applications of compressors	3	2		
	PC23. Identify lubricant requirement in a compressor	3	2		
	PC24. Monitor working of other associated units of a compressor	3	2		
	Total Marks	**72**	**48**		

Hydrogen Cooling & Compression systems	PC1. Know basic physical properties of hydrogen gas	3	2		
	PC2. Know physical properties of liquid hydrogen	3	2		
	PC3. Understand differences between Compressed hydrogen, Cryo-cooled hydrogen and liquid hydrogen	3	2		
	PC4. Follow the basic thermodynamics during cooling and compression of hydrogen	3	2		
	PC5. Identify energy requirements during cooling and compression of hydrogen	3	2		
	PC6. Identify different ways of liquifying hydrogen	3	2		
	PC7. Understand different types of cooling/chillers systems for hydrogen	3	2		
	PC8. Know performance parameters of a hydrogen compressor	3	2		
	PC9. Understand technical attributes of a hydrogen compressor	3	2		
	PC10. Identify different types of mechanical compressors suitable for compressing hydrogen	3	2		
	PC11. Identify different types of non-mechanical compressors suitable for compressing hydrogen	3	2		
	PC12. Understand mechanical compressor-reciprocating piston type	3	2		
	PC13. Understand mechanical compressor-diaphragm type	3	2		
	PC14. Understand mechanical compressor-Screw type	3	2		
	PC15. Understand mechanical compressor-centrifugal type	3	2		
	PC16. Monitor performance of different types of mechanical compressors	3	2		
	PC17. Coordinate with global suppliers of different types of mechanical compressors	3	2		
	PC18. Know about non-mechanical compressor-metal hydride compressor	3	2		
	PC19. Know about non-mechanical compressor-electrochemical compressor	3	2		
	PC20. Know about non-mechanical compressor-Adsorption compressor	3	2		
	PC21. Understand non-mechanical compressor-cryogen compressor	3	2		
	PC22. Monitor performance of different types of non-mechanical compressors	3	2		
	PC23. Coordinate with suppliers of different types of non-mechanical compressors	3	2		
	PC24. Identify possible impurities ingress during compression of hydrogen	3	2		
	PC25. Comprehend linkage of hydrogen compression and liquification with storage tanks	3	2		
	PC26. Identify Common Faults and their Analysis of Hydrogen Compressor	3	2		
	PC27. Know Safety issues while dealing with liquid hydrogen	3	2		
	PC28. Know safety issues while handling hydrogen compressors	3	2		
	PC29. Follow applicable standards for cooling and compression systems for hydrogen	3	2		
	Total Marks	**87**	**58**		
Roles and Responsibilities of a Cooling and compression Technician	**PC1.** Control valves to start compressor engines, pumps, and auxiliary equipment.	2	1		
	PC2. Read Monitors, meters, gauges, and recording instrument charts to ensure specified temperature, pressure, and flow of gas through system.	2	1		
	PC3. **Operate** of equipment to detect malfunctions.	2	1		

	PC4. Ensuring quality of hydrogen	2	1		
	PC5. Perform minor repairs on equipment, using hand tools.	2	1		
	PC6. Record instrument readings and operational changes in operating log.	2	1		
	PC7. Monitoring and reviewing information from materials, events, or the environment, to detect or assess problems.	2	1		
	PC8. Control machines and Processes -- Using either control mechanisms or direct physical activity to operate machines or processes	2	1		
	PC9. Proper handling and moving Objects	2	1		
	PC10. Inspecting equipment, structures, or materials to identify the cause of errors or other problems or defects.	2	1		
	PC11. Reading and Interpreting Electrical Schematics, Process Diagrams and Electrical One Line Diagrams	2	1		
	PC12. Perform calibration of analyzers and troubleshoot control systems.	2	1		
	PC13. Have a working knowledge of computers and typical computer programs (i.e. Excel, Word, Power Point, Outlook)	2	1		
	PC14. Monitors process performance and makes appropriate adjustments to remedy deviations and align to the specified norm.	2	1		
	PC15. Operates units to continuously supply products in quantities and qualities safely and economically, complying with all environmental regulations, quality standards, and daily customer requirements.	2	1		
	PC16. Safely operate, troubleshoot, and maintain all rotating equipment and associated mechanical systems including compressors, pumps, fans, blowers, boiler systems, and valves.	2	1		
	PC17. Collection of data and prepare reports in order to meet reporting requirements.	2	1		
	PC18. Carry out routine maintenance required in water treatment unit	2	1		
	PC19. To maintain and ensure continuous operation	2	1		
	PC20. To manage multiple work orders on multiple output stations (if applicable).	2	1		
	PC21. To report data and interface with other employees and departments.	2	1		
	PC22. To notifying management of safety issues and risks	2	1		
	Total Marks	**44**	**22**		
Onsite Training	**PC1.** Follow actual working of a green hydrogen facility	2	1		
	PC2. Understand working aspects of different units	2	1		
	PC3. Grasp detailed working of the hydrogen cooling systems	2	1		
	PC4. Follow detailed working of hydrogen compression system	2	1		
	PC5. Identify and list down Understand common faults occurring in these units	2	1		
	PC6. Note down routine maintenance issues with these systems	2	1		
	PC7. Understanding related storage systems and its integration with cooling-compression systems	2	1		

	PC8. Observe dispensing of hydrogen in vehicles	2	1		
	PC9. Follow the control room setup and automation	2	1		
	PC10. Understand working of online analyzers and sensors	2	1		
	PC11. Identify and Understand safety features employed in the facility	2	1		
	PC12. Prepare a short report of the visit and learnings	2	1		
	Total Marks	**24**	**12**		
Grand Total		**275**	**164**	0	0

Annexure: Assessment Strategy

This section includes the processes involved in identifying, gathering, and interpreting information to evaluate the Candidate on the required competencies of the program.

1. Assessment System Overview:
   - Batches assigned to the assessment agencies for conducting the assessment on SIDH or email
   - Assessment agencies send the assessment confirmation to VTP/TC looping SSC
   - Assessment agency deploys the ToA certified Assessor for executing the assessment
   - HSSC monitors the assessment process & records

2. Testing Environment:
   - Confirm that the centre is available at the same address as mentioned on SDMS or SIDH
   - Check the duration of the training.
   - Check the Assessment Start and End time to be as 10 a.m. and 5 p.m.
   - Check that the allotted time to the candidates to complete Theory & Practical Assessment is correct.
   - Check the mode of assessment—Online (TAB/Computer) or Offline (OMR/PP).
   - Confirm the number of TABs on the ground are correct to execute the Assessment smoothly.
   - Check the availability of the Lab Equipment for the particular Job Role.

3. Assessment Quality Assurance levels/Framework:
   - Question bank is created by the Subject Matter Experts (SME) of Hydrocarbon Sector are verified by the Industry Experts, each performance criteria have its marks for theory based on the level of question i.e., easy, medium and difficult.
   - Questions are mapped to the specified assessment criteria
   - Assessor must be ToA certified & trainer must be ToT Certified

4. Types of evidence or evidence-gathering protocol:
   - Time-stamped & geotagged reporting of the assessor from assessment location
   - Centre photographs with signboards and scheme specific branding
   - Biometric or manual attendance sheet (stamped by TP) of the trainees during the training period
   - Time-stamped & geotagged assessment (Theory + Viva + Practical) photographs & videos

5. Method of verification or validation:

- Surprise visit to the assessment location
- Random crosschecking with candidate over audio/video call or physical visit
- Random audit of the batch

6. Method for assessment documentation, archiving, and access

- Hard copies of the documents are stored
- Soft copies of the documents & photographs of the assessment are uploaded / accessed from Cloud Storage
- Soft copies of the documents & photographs of the assessment are stored in the Hard Drives

7. On the Job:

1. The evidence record of OHT will be done through organized Monitoring Reports
2. During the OJT, every trainee is required to fill the OJT monitoring report which is required to be signed by his/her supervisor and the HR of that company.
3. During assessment, each module will be assessed separately.
4. The candidate must score 60% in each module to successfully complete the OJT.
5. Tools of Assessment that will be used for assessing whether the candidate is having desired skills and etiquette of dealing with customers, understanding needs & requirements, assessing the customer and perform Soft Skills effectively:
   • Videos of Trainees during OJT
6. Assessment of each Module will ensure that the candidate is able to:
   - Effective engagement with the customers
   - Understand the working of various tools and equipment

Annexure: Acronym and Glossary

Acronym

Acronym	Description
AA	Assessment Agency
AB	Awarding Body
ISCO	International Standard Classification of Occupations
NCO	National Classification of Occupations
NCrF	National Credit Framework
NOS	National Occupational Standard(s)
NQR	National Qualification Register
NSQF	National Skills Qualifications Framework
OJT	On the Job Training

Glossary

Term	Description
National Occupational Standards (NOS)	NOS define the measurable performance outcomes required from an individual engaged in a particular task. They list down what an individual performing that task should know and also do.
Qualification	A formal outcome of an assessment and validation process which is obtained when a competent body determines that an individual has achieved learning outcomes to given standards

Qualification File	A Qualification File is a template designed to capture necessary information of a Qualification from the perspective of NSQF compliance. The Qualification File will be normally submitted by the awarding body for the qualification.
Sector	A grouping of professional activities on the basis of their main economic function, product, service or technology.
Long Term Training	Long-term skilling means any vocational training program undertaken for a year and above. https://ncvet.gov.in/sites/default/files/NCVET.pdf