

Disaster Management



Hydrogen Based, Containerized and Mobile Life
Support System for Pakistan

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1. PREFACE

Over the past 50 years, natural hazards in South and South-West Asia have affected over 3 billion people and killed more than 1 million.

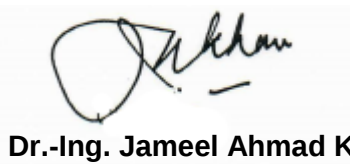
We have also experienced disasters of huge dimensions. The experience shows that our disaster management system does not readily provide immediate relief.

The Pakistan Academy of Engineering specializes in the application of new hydrogen technologies for the benefit of our country. After considerable effort a **Hydrogen Based Containerized and Mobile Life Support System** has been designed keeping in mind the needs of drinking water, fuel for cooking, heating and availability of power via Solar Energy. A population of 150 persons may be served by this module.

Japan is the only country to have developed a similar life support system, which is in operation at present.

It is recommended that the Disaster Management Fund may be approached to get the concept materialized, and finally put into active operation, when the need arises.

Project has been prepared with the financial support of the Pakistan Engineering Council.



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2. Executive Summary

Climate change is increasing the occurrence and intensity of natural hazard-induced disasters in South and South-West Asia. The Islamic Republic of Pakistan is also affected by climate change, increased urbanization, environmental degradation, and increasingly severe and larger scale natural disasters. Pakistan is prone to natural hazards such as drought, floods, heat waves, extreme cold, earthquakes, and glacier melting. According to the Climate Risk Index 2021, Pakistan ranks eighth for countries most affected by extreme weather events between 2000 and 2019.

Pakistan has experienced a series of hazards in recent years. Drought-like conditions, which began in late 2018 and continued through 2019, affected five million people with 2.1 million people targeted for humanitarian assistance. This was followed by a winter emergency affecting one million people across much of the western part of the country. The worst desert locust infestation in 27 years was declared a national emergency by the Government in January 2020. This was followed with the Coronavirus Disease 2019 (COVID-19) pandemic, which began in February 2020 and contributed to health and economic shocks, a disruption in education, and increased food insecurity. In September 2020, the Government declared a national emergency due to heavy monsoon rains that triggered major floods in Sindh Province and affected an estimated 2.4 million people.

The Government of Pakistan has a strong disaster management foundation built around the National Disaster Management Authority (NDMA), the Provincial Disaster Management Authorities (PDMA), and national legislation from 2010.

Natural hazards can damage energy infrastructure and disrupt power supply. Extreme temperature and changes in precipitation can reduce the capacity of transmission lines, transformers and substations. Therefore, the need for an independent energy infrastructure life support system is inevitable. The proposed Hydrogen based Life Support System is designed to cater the needs of drinking water, cooking and hot water to provide the relief to the affected people in the event of a disaster. This system can also be used in non-disastrous conditions.

Being able to use the renewable solar energy, store it in the form of hydrogen and container mounted on a truck to be mobile along with the availability of drinking water and cooking stove are the salient features of this Hydrogen based Life Support System.

3. Scenario of Disasters

Natural disaster is a major adverse event resulting from natural processes of the Earth; examples include firestorms, dust storms, floods, hurricanes, tornadoes, volcanic eruptions, earthquakes, tsunamis, storms, and other geologic processes. Pakistan is prone to natural hazards such as drought, floods, heat waves, extreme cold, and earthquakes.

3.1 Disaster Overview

3.1.1 Climate Change

Climate change poses one of the biggest threats that Pakistan faces. Over the past 50 years, Pakistan's annual mean temperature has increased by 0.5°C (by 0.9°F) and is expected to rise by 3-6°C (by 5.4-10.8°F) by the end of this century, increasing the risk of widespread droughts. While annual precipitation has increased, the frequency and variability of rain has become unpredictable. While Pakistan as a whole faces challenges associated with climate change, the agricultural industry and nationwide food supply are impacted the most by such drastic changes in temperature and rainfall.

Much of the country contains dry, arid desert land where farmers rely on regular monsoon rains to bring relief to the region and to water crops. While some infrastructure in rural regions allows for water storage in irrigation, these resources have been tested as prolonged droughts see farmers relying heavily on agricultural infrastructure instead of naturally replenished water sources.

Pakistan's high vulnerability to climate change is linked to widespread food and nutrition insecurity. Changing, erratic, and intense weather patterns resulting from climate change make farming and irrigation challenging. Availability of food and stable agricultural infrastructure are upended by unpredictable weather patterns. Disruptions in the food supply directly impact the livelihood of Pakistan's population, of which half depend on the country's agriculture sector. In 2018, a survey found that at least 23.5% of households in Pakistan were moderately to severely food insecure and 10.1% of households were severely food insecure. Although Pakistan is considered a food surplus country, producing more than enough food for its population, droughts have taken a toll on output needed to curb malnutrition. Increasing temperatures are causing high evaporation rates, and, as a result, the demand for water irrigation is likely to increase.

3.1.2 Hazards

Pakistan experiences the following natural hazards:

Flooding and Landslides

Regular rains from seasonal monsoons can bring relief to farmers seeking water for crops. However, these occurrences also cause

widespread floods, flash floods, and landslides, which devastate communities and agricultural areas. Pakistan's monsoon season runs roughly June through September. Rural regions, especially the southern districts of Sindh and Balochistan, can be devastated by flash floods and landslides that wash villages and farmland away while blocking essential roads to remote areas.

Urban areas, especially Karachi, have experienced some of the worst urban flooding in the history of the country. Streets and homes are quickly overwhelmed by rain and sewage water due to outdated drainage systems. Poor city planning is often to blame during urban flooding disasters.

A type of flooding of special concern in Pakistan is Glacier Lake Outburst Floods (GLOF). The combination of high-altitude glaciers in the Hindu Kush, Himalayas, and Karakorum and climate change on top of simple seasonal changes means that sudden water flow from glaciers into glacial lakes can set off a series of events. This excess water can only flow into the V-shaped canyons that carry normal flow, and the sudden, rapid rise in water levels can destroy lives, livelihoods, ecosystems, and infrastructure in its path. Areas of northern Pakistan are, of course, at the highest risk of GLOF. A recent study found that accelerating glacier melt has created more than 3,000 glacial lakes in Gilgit- Baltistan and Khyber Pakhtunkhwa, and of these lakes, 33 are assessed as prone to hazardous GLOF, putting 7.1 million people at risk.

Cyclones

Pakistan is at high risk of impact by cyclones with Sindh, Balochistan, and Punjab at “high,” “medium,” and “low” risk, respectively. More northerly, mountainous regions are considered to be at “very low” risk for this hazard. The threat of cyclone damage stems not only from the potential for high winds but also for storm surge as well as heavy rains and flooding that result from storms making landfall in coastal areas. As cyclonic activity in the Indian Ocean changes with the impact of climate change, the frequency of storms is expected to decrease on average whereas wind speed and rainfall of each storm is expected to rise.

Earthquake

The mountainous regions of northern and northeastern Pakistan are prone to frequent and sometimes devastating earthquakes. While Pakistan has experienced several earthquakes resulting in widespread damage and loss, the 2005 earthquake has eclipsed any in history as the most catastrophic; it left 73,000 people dead while eight districts across Pakistan reported damage and loss. Recovery efforts were made difficult as the hardest hit areas were located in remote, mountainous regions where equipment for reconstruction had to be navigated through steep terrain and harsh weather conditions.

Drought

Drought has become the main disaster that Pakistan must address on a long-term basis with devastating droughts often spanning years. Food insecurity is rising at an alarming rate as 36.9% of the population is already food insecure. A drought spanning 1998-2002 was the worst in 50 years; however, consistent drought conditions since 2013 have drawn comparisons as five million people have been affected in Sindh and Balochistan districts where the drought has persisted. As a country that relies heavily on its own food production, droughts in these heavily agricultural regions have caused a domino effect, leading to low food, crop, and water supplies.

As a result, malnutrition and food insecurity is widespread, especially among children. Twelve million children in Pakistan are considered to have stunted growth, a national rate of 40.2%. Drought has hit the poor harder than any other demographic, with some of Pakistan’s poorest populations residing in drought affected districts. [2]

3.2 Pakistan's Risk Profile

Risk calculation takes into account exposure to hazards, vulnerability, and institutional coping capacity, all of which are important factors in Disaster Risk Management. The Index for Risk Management (INFORM) Global Risk Index (GRI) measures the risk of humanitarian crises and disasters in 191 countries. The INFORM GRI supports a proactive crisis management framework. INFORM GRI is helpful for establishing an objective allocation of resources for disaster management as well as for coordinating actions focused on anticipating, mitigating, and preparing for humanitarian emergencies. The INFORM GRI model is based on risk concepts published in scientific literature with three dimensions of risk: Hazards & Exposure, Vulnerability, and Lack of Coping Capacity. The first dimension measures the natural and human hazards that pose the risk. The second and third dimensions cover population factors that can mitigate against or exacerbate the risk. The vulnerability dimension considers the strength of individuals and households relative to a crisis while the lack of coping capacity dimension considers factors of institutional strength.

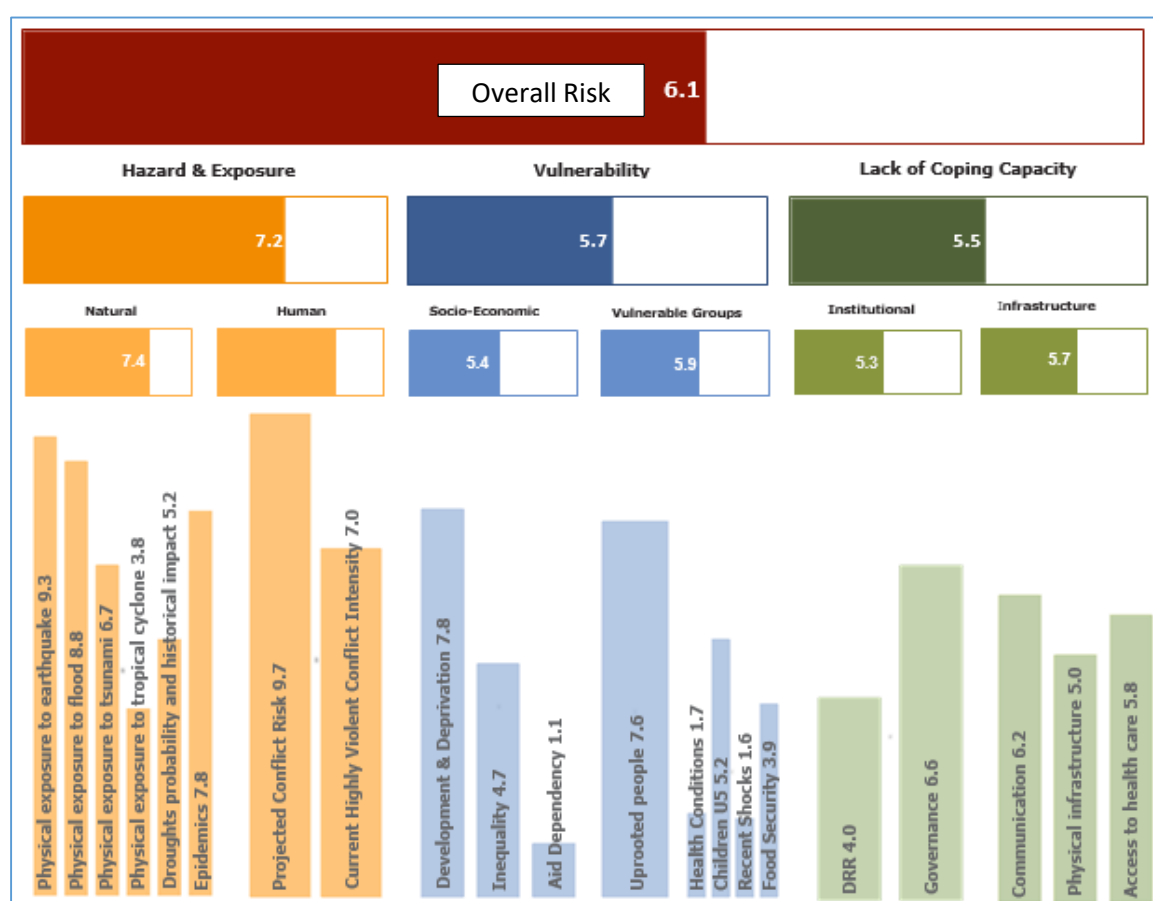


FIGURE 3.1: INFORM Risk Index for Pakistan, 2021 [2]

The INFORM GRI model is split into different levels to provide a quick overview of the underlying factors leading to humanitarian risk. INFORM gives each country a risk score of 1-10 (1 being the lowest and 10 the highest) for each of the dimensions, categories, and components of risk, as well as an overall risk score. The higher the score the more at risk a country is to disasters.

In the 2021 INFORM Global Risk Index, Pakistan had an overall risk of 6.1/10, which INFORM categorizes as the “High Level” risk class. The Hazards and Exposure dimension score takes into account a combination of both natural and human hazards, in which Pakistan rated 7.2/10. The Vulnerability dimension score was 5.7/10, and the Lack of Coping Capacity dimension score was 5.5/10. Physical exposure to earthquake, 9.3/10, was the highest risk in the Hazards & Exposure dimension due to natural hazards, though it was exceeded by a Projected Conflict Risk score of 9.7/10 due to human hazards. The Development and Deprivation risk category, measuring at a 7.8/10, was the highest-risk category within the Vulnerability dimension. Governance was rated the highest risk category, at 6.6/10, in the Lack of Coping Capacity dimension. Figure 3.1 displays the 2021 INFORM GRI for Pakistan.

3.3 Economic Cost of Cascading Hazards and Climate Change

ESCAP (The Economic and Social Commission for Asia and the Pacific) estimated the economic costs from the combined impacts of the disaster-climate-health nexus, considering two climate change scenarios. In South and South-West Asia, the total average annual loss (AAL) is estimated to be \$161 billion in the current climate condition.

This estimate increases to \$217 billion under the moderate climate change scenario (RCP 4.5) and to \$322 billion under the worst- case climate change scenario (RCP 8.5) (2020–2059 projections). In absolute terms, under the worst-case scenario, India is set to record the highest AAL at \$225 billion, followed by Pakistan at \$26 billion and Turkey at \$24 billion (Figure 3.2).

However, when AAL is assessed as a percentage of the country’s GDP the picture changes. For example, under the worst-case climate change scenario, Pakistan will have the highest losses as percentage of GDP at 9.1 per cent, followed by Nepal at 8.7 per cent. In this scenario, India will still be the fifth highest, with estimated losses equaling 8.1 per cent of its GDP. [3]

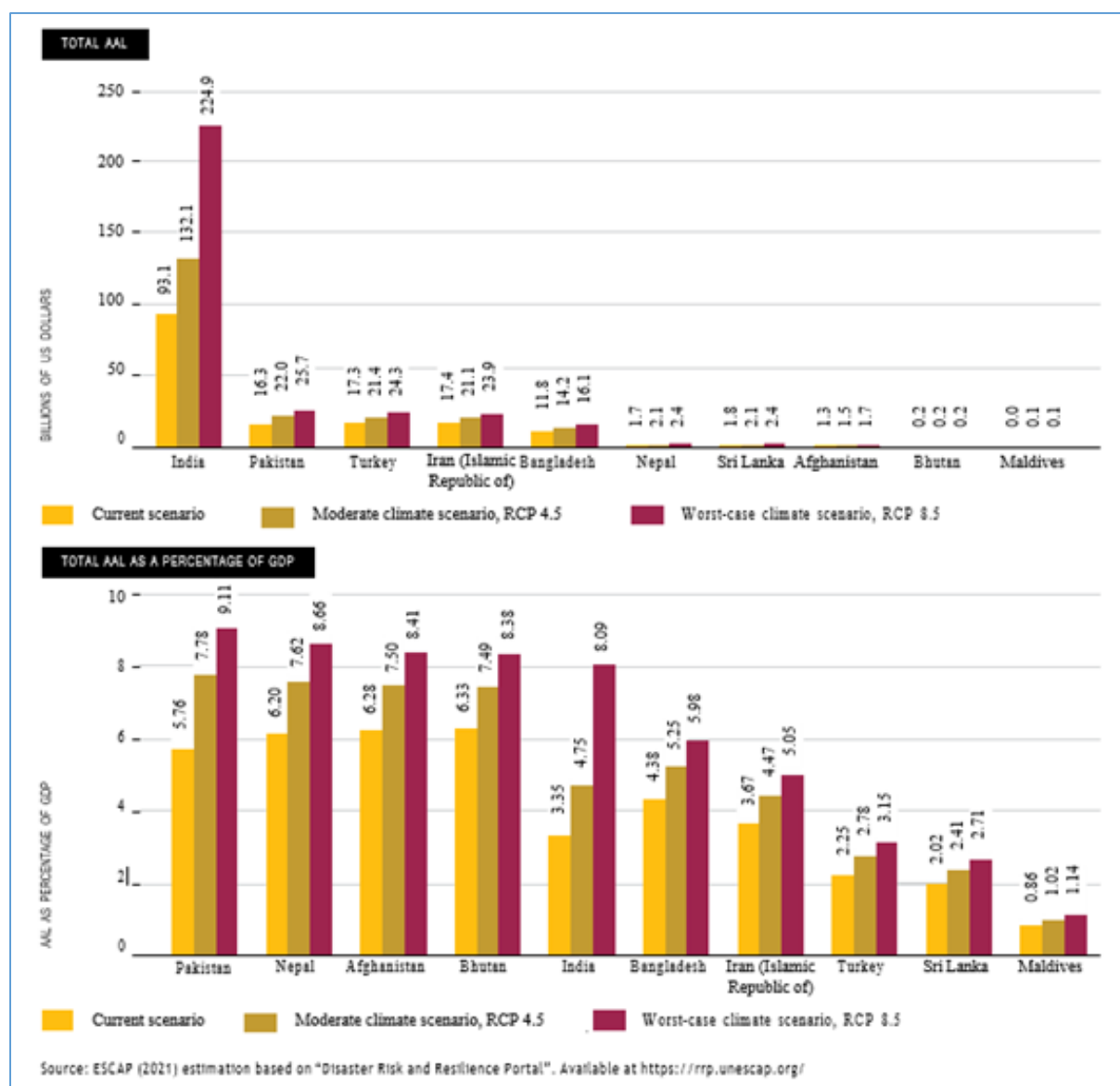
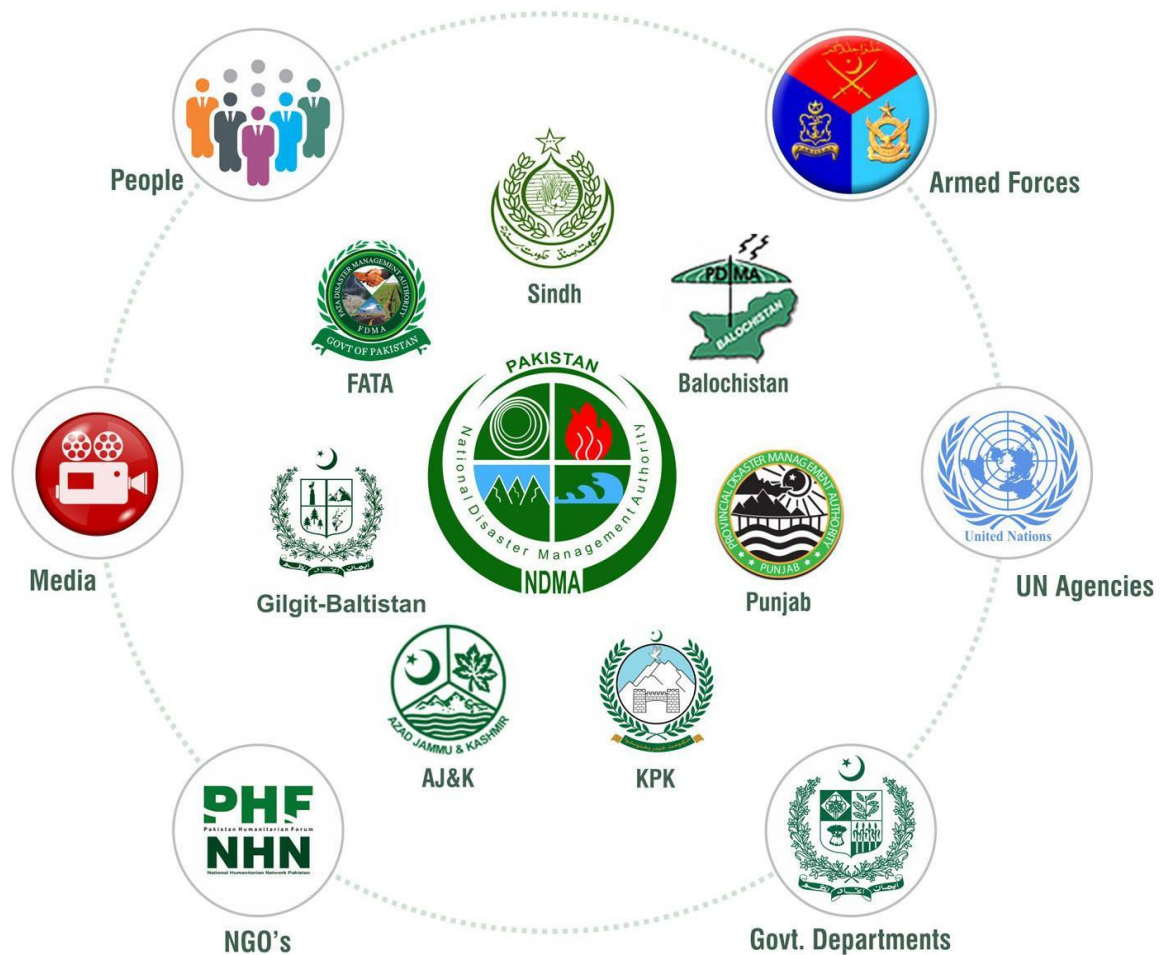


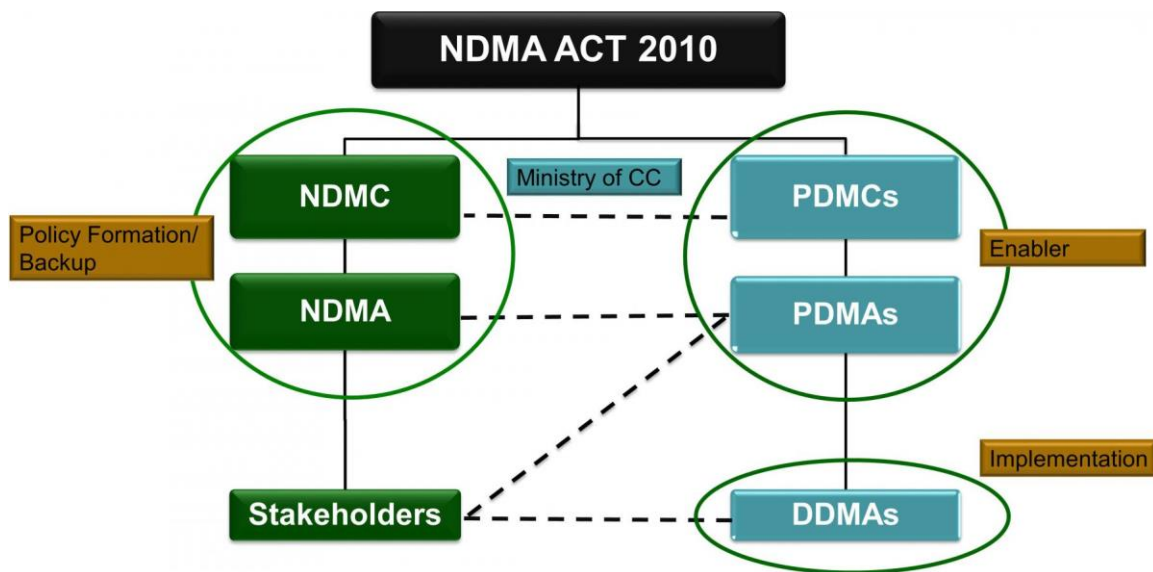
FIGURE 3.2 Total Average Annual Loss (AAL) and Average Annual Loss (AAL) as Percentage of GDP from cascading risks [3]

4. Disaster Management in Pakistan

National Disaster Management Authority (NDMA) is the lead agency at the Federal level to deal with the whole spectrum of Disaster Management activities. It is the executive arm of the National Disaster Management Commission (NDMC) which has been established under the Chairmanship of the Prime Minister as the apex policy making body in the field of Disaster Management. In the event of a disaster, all stakeholders including Government Ministries/Departments/Organizations, Armed Forces, INGOs, NGOs, UN Agencies work through and form part of the NDMA to conduct one window operations. It is established under the National Disaster Management Act – 2010 and functions under the supervision of National Disaster Management Commission (NDMC) which is headed by the Prime Minister of Islamic Republic of Pakistan. NDMA manages the whole Disaster Management Cycle (DMC) which includes Preparedness, Mitigation, Risk Reduction, Relief and Rehabilitation. A National Disaster Management Plan (NDMP) is prepared and is followed towards provision of better services to the affected ones. [1]



STAKEHOLDERS [1]



DISASTER MANAGEMENT STRUCTURE [1]

NDMA has been doing their best to provide the relief in the event of a disaster to not only inside Pakistan but also providing relief to the neighboring countries when they are faced with natural disaster.

Latest Example: Afghanistan earthquake - At least 1,000 people killed and 1,500 injured

NDMA has already sent the first consignment of relief goods on 23 June 2022 via road. The second consignment arranged by the National Disaster Management Authority consists of family tents and essential food items, which has been dispatched through PAF C130 Air Craft.

History of Natural Disasters

The following is a list of natural disasters in Pakistan in the last ten years.

Drought, Locust Infestation, Floods, and Pandemic-2020-2021

During 2020 and stretching into early 2021, the population of Balochistan, which already experiences the highest prevalence of food insecurity, malnutrition, and poverty in Pakistan, faced multiple shocks including high food prices, locust outbreaks, rains, flooding and snowfall, all exacerbated by the impacts of the COVID-19 pandemic. Most of the districts classified as arid with high dependency on rainfall did not receive rain between April and November 2020.

Due to deficiency of pre-winter and winter rainfall, a moderate drought-like condition emerged in southern and western parts of Balochistan. Around 760,000 people were estimated to be facing high levels of acute food insecurity during the period March-June 2021, corresponding to the end of the lean season and the beginning of the harvest season. Looking forward to July-September 2021, corresponding to the post-harvest season, indicates that the number of people in Crisis and Emergency phases is expected to fall by only about 30,000.

Floods and Landslides-August 2020

Severe monsoon rains during August and September resulted in urban flooding. A reported 409 people were killed and 402 injured across several districts, with Sindh being the hardest hit. The flood wiped out the region's staple crops and disproportionately affected women who work as farm laborers. Food insecurity has been widespread as a result. Following the floods, a massive landslide occurred in the Gilgit-Baltistan region in October; it killed 16 people and damaged roads.

Earthquake-September 2019

A high-intensity 5.8-magnitude earthquake struck at a shallow depth of 10 km and damaged homes in Mirpur and Bhimber districts of Azad Jammu and Kashmir. The quake resulted in 38 deaths and over 646 injuries with crucial electrical lines and mobile and landline phone services disrupted. Families in the area were severely affected as over 8,500 households reported full or partial damage as a result of the quake. Recovery efforts also focused on the main road from Mirpur to Jatlan and the Jatlan Canal, both of which experienced severe damage that harmed people in vehicles near the structures during the event.

Floods and Landslides-July 2019

Heavy rain over the northeastern region of Pakistan triggered flash floods and landslides. Over the span of two months the gradually rising death toll saw 225 fatalities and 166 injuries as a result of floods, landslides, and mudflows. Torrential rain swept away over 200 houses, and search and rescue operations evacuated people to relief camps. Standing water in flooded areas hampered relief and rescue operations.

Drought-2018-2019

A prolonged, widespread drought affected over five million people across Balochistan, Sindh, Punjab, and Gilgit Baltistan provinces. The drought was a result of a monsoon season that brought less rain than anticipated. Over 70% of households in the affected areas were reported to be food insecure with malnutrition rates increasing to over 30%. The situation became one of the worst disasters in Pakistan. Minimal or no rainfall persisted across the affected regions, completely drying up drinking water resources and lessening water available through springs and wells. A pattern of increased temperatures in the region suggests an overall deterioration of water availability over the next few years. Government-run relief programs were only able to reach about 2.5 million people, half of the overall population affected.

Floods and Heavy Snowfalls-Jan 2017

Heavy rain and record-breaking snowfall resulted in flooding across Balochistan province over a week in January 2017. Over 60,000 people in the province sought government assistance, but only 6,000 were provided support. Some 13 deaths and 650 injuries were reported, with additional deaths and injuries reported after an avalanche and landslide occurred following the floods.

Floods and Landslides-June 2016

A severe windstorm brought heavy rain to Rawalpindi, Islamabad, Peshawar, and Lahore, killed 226 people, and injured hundreds of others after flash flooding and landslides destroyed homes. The city of Lahore spent several days without power due to flood damage.

Floods and Landslides-March 2016

A premature storm ahead of typical monsoon season left at least 262 people dead and injured

223. Most of the fatalities occurred in Khyber Pakhtunkhwa where flooding and landslides damaged over 2,700 homes. Food shortages and telecommunication outages were also reported during the storm and its aftermath. Over 300,000 families were registered as internally displaced, with only half returning to their places of origin.

Hindu Kush Earthquake-October 2015

An earthquake registering 7.5 magnitude struck Badakhshan province with reports of people also feeling the impact of the quake in Afghanistan and India. The epicenter was in the Hindu Kush mountain range on the border between Pakistan and Afghanistan. Extensive property damage in remote locations made relief efforts difficult and prolonged. Over 25,000 homes were damaged in Pakistan alone with nearly as many damaged in Afghanistan.

Floods-April 2015

A severe storm affected several parts of Pakistan with unseasonably heavy rainfall. The hardest hit areas of Balochistan, Gilgit-Baltistan, Punjab, and Sindh experienced widespread infrastructure damage and population displacement. Since the storm occurred before monsoon season, the event was dubbed a “mini- cyclone” due to the abnormal intensity of the storm so early in the season. The heavy rains combined with rapidly melting snow and runoff from glacial lakes, which led to flash floods and major flooding of the Indus River in Pakistan. Over 285,000 people were affected with 238 deaths and 232 injuries. The Pakistan Army and Government responded to the immediate needs of affected populations, evacuated more than one million people, and moved them to relief camps.

Floods-September 2014

In early September 2014, flash floods affected Punjab, Gilgit Baltistan, and Azad Jammu and Kashmir. Heavy monsoon rains brought intense flooding, which damaged homes and caused widespread destruction to farmlands and livestock. Over 2.5 million people were affected by the floods, and over 250,000 farmers lost farmland totaling over one million acres. A reported 367 people died in the floods; however, the total does not take knock-on health effects resulting from the floods into account. After returning to their places of origin, the displaced population suffered respiratory illnesses, diarrhea, and skin diseases, which required further assistance beyond immediate flood relief.

Drought-2014-2017

Beginning in 2013, Tharparkar district, Sindh, reported an increase in deaths related to chronic malnutrition. Low rainfall resulted in widespread crop failure and loss of livestock. As the drought worsened, access to reliable water sources became difficult, and waterborne illnesses became more common in the region. At the same time, an outbreak of sheep pox killed thousands of small animals. Malnutrition rates soared among children and adults, with children comprising most of the deaths and hospitalizations, due to the food shortages and water scarcity. From the rural region, families have to travel an average of 17 km to access health facilities. As drought conditions eventually improved, a joint UN observation mission took place in Tharparkar,

Umarkot, and Sanghar districts, and findings stated that the situation could quickly deteriorate into a “humanitarian emergency” if needs were not met and rainfall levels remained low. Estimates found that hundreds of adults and children died during the drought and tens of thousands were hospitalized over the course of several years. An El Niño storm system at the end of 2017 eventually brought rains to the region.

Earthquake Awaran-September 2013

A large earthquake struck the province of Balochistan in a remote, mountainous section of the region. The initial intensity was measured at 7.7 magnitude. A few days later an aftershock measuring 7.2 magnitude hit southwest Balochistan. The earthquake resulted in 399 deaths and 599 injuries. Further fatalities, injuries or widespread damage was averted due to the remote, rural location.

Balochistan Flood-August 2013

Several days of heavy rains due to monsoons caused widespread flooding in Balochistan. Authorities prioritized clearing the sewage system in order to begin work on flooded infrastructure. Lasting damage affected major road systems and displaced populations who were temporarily housed on canal banks.

Earthquake Washuk (Mashkel)-April 2013

A 7.8 magnitude earthquake hit a section of the Balochistan region on the Iran-Pakistan border. The earthquake caused the collapse of hundreds of houses, resulting in thousands left homeless across remote villages in the area. Nearly 90% of Mashkel, a moderately sized town in the region, was flattened by the quake.

Balochistan Flood-August-September 2012

Seasonal monsoon rains resulted in widespread flooding across Punjab, Sindh, and Balochistan provinces. While the initial monsoon rains came late in the season, an intense, late season burst caused flooding, infrastructure damage, and casualties. Balochistan province was hit the hardest with rural farms and livestock washed away by the flood.

It is important to note that two major disasters in Pakistan’s history, a 2005 earthquake and floods throughout July 2010, were some of Pakistan’s largest ever natural disasters and resulted in massive human and infrastructure loss. There was a substantial international response including a significant civil-military coordination component, with the U.S. military among the responders.

The October 2005 7.6 magnitude earthquake, which struck South Asia, devastated northern Pakistan, specifically the Azad Jammu and Kashmir region. The quake resulted in over 75,000 deaths; some 128,300 people were severely injured, and over 3.5 million people were left homeless. During the earliest stages of the recovery effort the Pakistan Army stepped in and completed one of the most effective responses to a disaster of this scale with assistance from global partners, including the U.S. armed forces.

Pakistan’s 2010 monsoon season was marked by a massive Indus River swell moving from the Himalayas down to the Arabian Sea. This flood became one of the most tragic disasters in Pakistan’s history. More than 20 million people were affected by the flooding as populations lost their homes and livelihoods. While much of the country was affected by the disaster, the provinces

of Khyber Pakhtunkhwa, Punjab, and Sindh experienced the worst damage. At least 1,700 people died, and over 7 million people were left homeless. Collaboration between the Government of Pakistan, Pakistan Armed Forces, the U.S., and global agencies was ongoing even as flooding in 2011 and 2012 continued to devastate the region. [2]

5. Hydrogen Based Life Support System Design

In order to develop a life support system which is independent, sustainable and environment friendly, globally hydrogen with renewable energy is considered as a solution.

5.1 Size of Population Served

150 people population size in the case of emergency will be supplied with water (via R.O Plant) for drinking purposes. They will be able to use cooking stove / grill for their cooking needs. Hot water will also be available for their needs.

5.2 System Design (Circuit Diagram)

Following is the system diagram of Hydrogen based Life Support System:

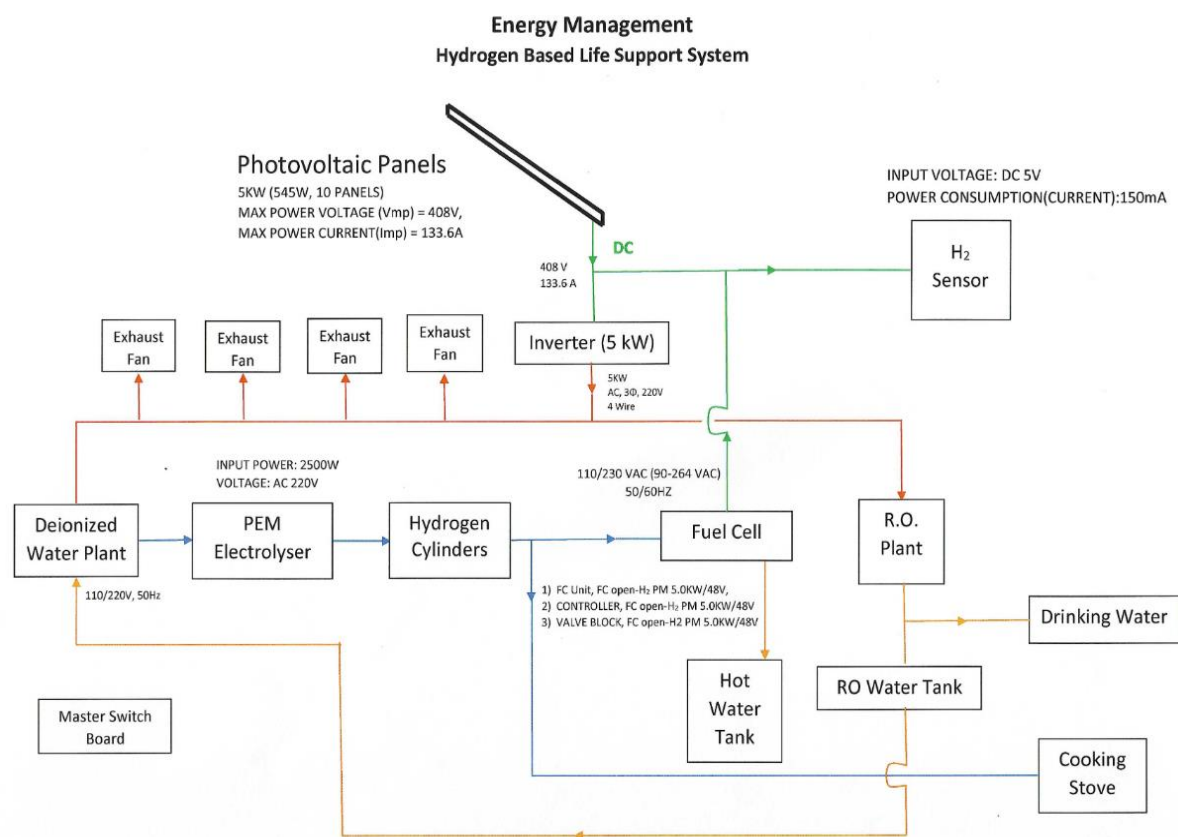


FIGURE 5.1 Energy Management System Diagram (Hydrogen Based Life Support System)

5.3 Mobile, Truck Mounted and Containerized System

The hydrogen production will be onsite with the help of PEM electrolyzer and then hydrogen will be supplied to Fuel cell for power generation and cooking use. The entire system will be containerized and truck mounted in order to be mobile.

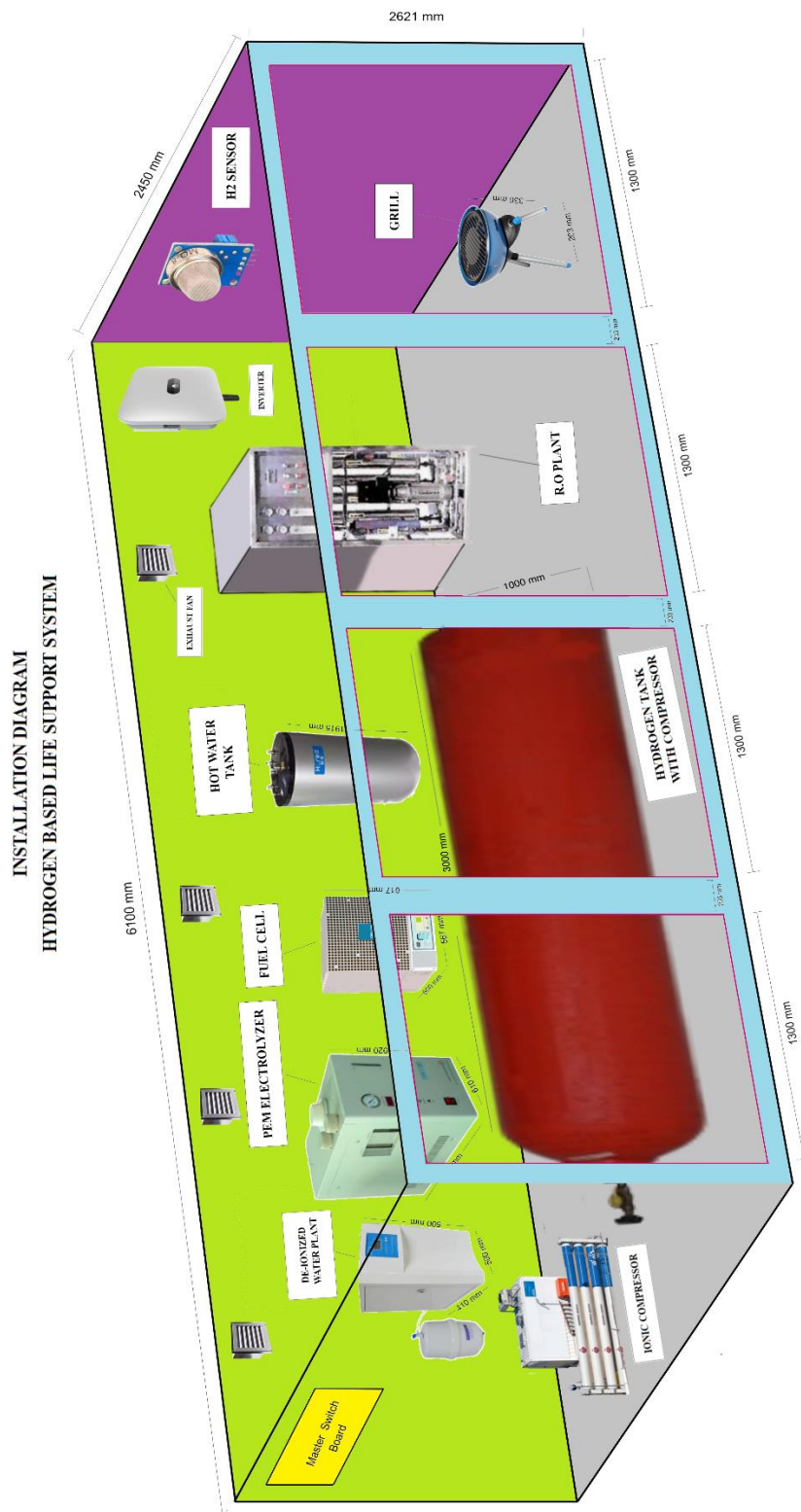


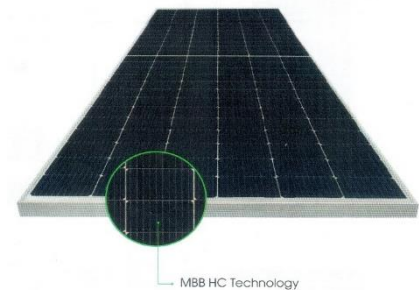
FIGURE 5.2 Installation Diagram (Hydrogen Based Life Support System)

6. Design of Components

Following components are part of the design of Hydrogen based Life Support System

6.1 Solar Panels

PV Solar panels will be used to supply electricity to the system.



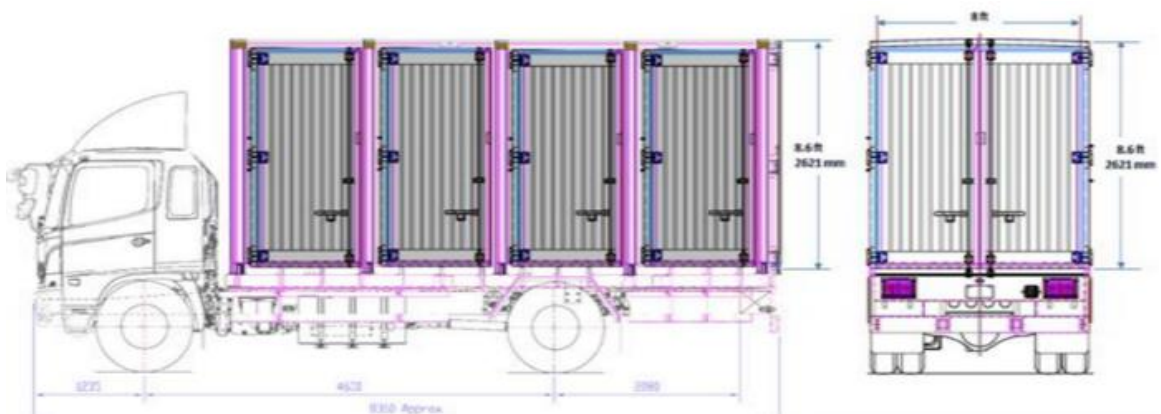
6.2 Inverter

Inverter will be used to convert the DC current into AC current.



6.3 Truck

Hinopak Truck will be used and container will be mounted on the truck.



6.4 Container

All the necessary equipment (as shown in Figure 5.2) will be housed in a 20 ft. container.

6.5 De-ionized Water Plant

This De-ionized water plant is used to provide the required de-ionized water to PEM electrolyzer,



6.6 PEM Electrolyzer for Hydrogen Production

PEM Electrolyzer will be used for hydrogen production.



6.7 Fuel Cell for Power Generation

Fuel Cell will be used for power generation.



6.8 Hot Water Tank

Hot water tank will be used to store hot water.



6.8 R.O. Plant for Drinking Water

R.O. Plant will be used to provide drinking water and water to De-ionized Water Plant.

6.9 Hydrogen Tank

High pressure hydrogen storage tank coupled with compressor will be used for hydrogen storage.



6.10 Integrated Energy Management System

The integrated energy management system is the backbone for the energy supply in Hydrogen Based Life Support System.

6.11 Hydrogen Sensor

Hydrogen sensor will be used to detect hydrogen.



6.12 Stove/Grill

It will be used for cooking fueled by hydrogen.



6.13 Exhaust Fans

Exhaust fans will be used for proper ventilation of container.

6.15 Spare Parts

All the spare parts required for the equipment will need to be procured, as per OEM guidelines.

7. Estimated Cost

The following table provides the cost estimate of the Hydrogen Based Containerized and Mobile Life Support System.

Item	Amount ('000) Rs.
Hinopak Truck	13,200,000
20 ft Container	1,485,000
Photovoltaic Panels	382,000
Inverter	220,000
De-ionized Water Plant	229,000
PEM Electrolyzer	4,326,000
2000W Fuel Cell (Qty=3)	13,230,000
Hot Water Tank	42,000
Hydrogen Tank with Compressor	2,000,000
RO Plant	950,000
Drinking Water Storage Tank	13,000
Cooking Grill / Stove	20,000
Hydrogen Sensor	1,000
Exhaust Fans (Qty.= 4)	12,000
Plywood Container Paneling	1,200,000
Equipment Cost	37,310,000
Design (10% of the cost of the equipment)	3,731,000
Spares @ 20% of the equipment cost	7,462,000
Pre-shipment Inspection @ 5% of the equipment cost	1,866,000
Energy Management @ 10% of the equipment cost	3,731,000
Installation @ 10% of the equipment cost	3,731,000
Total	95,141,000

8. Fabrication

Some local fabrication will be required for appropriate mounting, installation, erection and commissioning of Hydrogen based Life Support System.

9. Testing Phase

The testing of this system will be done by trained and qualified personnel. This will be done after the proper signoff of installation, erection and commissioning activities under the guidance and supervision of trained personnel due to the hazardous environment. This is extremely important so that we have a safe and smooth functioning of the Hydrogen Based Life Support System,

10. Training of Technician

The service maintenance personnel will be required to undergo safe operation training (due to hazardous environment) as well as service and maintenance aspects of the Hydrogen Based Life Support System. After the completion of all the required training, they will be responsible for all the service and maintenance of the Hydrogen Based Life Support System.

11. References

- [1] **National Disaster Management Authority**, <https://cms.ndma.gov.pk/>, (2022).
- [2] **CFE-DM**, PAKISTAN Disaster Management Reference Handbook, WWW.CFE-DMHA.ORG, (JUNE 2021).
- [3] **The Economic and Social Commission for Asia and the Pacific (ESCAP)**, Pathways to Adaptation and Resilience in South and South-West Asia, Asia-Pacific Disaster Report 2022 for ESCAP Subregions, (2022).

12. Annexures

SPECIFICATIONS OF THE EQUIPMENT

12.1 Truck



QUOTATION

Customer: The Pakistan Academy of Engineering (PAE) Karachi.	MCN No.:	250160-BHK
	Dated:	June 30, 2022
Consignee: As above	Sales Region:	South
	Price Basis:	Ex-Plant Karachi
	Validity:	July 07, 2022
	Delivery:	3~4 Months from order confirmation along with 100% Advance Payment received.
	Color:	Hinopak's Standard
	Payment:	100% advance through Pay Order/Bank Draft In favor of "Hinopak Motors Limited"
	NTN #:	34-01-0815070-2
	Income Tax Exempted #:	Under SRO 18 U/S. 153 (4)
	Sales Tax #:	02-02-7610-003-73
	ISO 9001:2015 #:	MER 19.184/UQ dated 22-08-2019
	ISO 14001:2015 #:	MER 19.621/UE dated 23-01-2020
	ISO 45001:2018 #:	MER 20.044/UOH dated 28-01-2021

GOODS & PRICES:

S. No.	Products	Spec's #.	Qty	Unit Price Rs.	Total Amount Rs.
01.	Euro-2 Hino FG8JLKB (4x2) Truck Chassis with Drivers Cabin only.	Standard	1	11,282,051	11,282,051
	17% GST:			1,917,949	1,917,949
	Final Price:			13,200,000	13,200,000

Other Terms:

1. Manufacturer: Hinopak Motors Ltd.
2. Warranty of Chassis: 12 months or 100,000 km, whichever occurs first from delivery of vehicle.
3. Above price is inclusive of 17% General Sales Tax.
4. This proposal is subject to standard force majeure terms and conditions including any interruption in production / Supply / Assembly caused by lockdowns imposed by the Governments of Japan / or Pakistan. Delivery period may please increase due to change in supply chain schedule by COVID-19 pandemic.
5. The quoted price is based on prevailing exchange rate of Japanese Yen/US \$ and fluctuation on current applicable duties, taxes and other government levies. In case of any levies or imposition of any new duties or taxes (Sales Tax, RGST, VAT, Flood Surcharge, Excise Duty etc.), at the time of delivery, our quoted prices will change accordingly which will be entirely on customer's account.

This offer is subject to availability of stocks and prior sale and the General Terms & Conditions as printed on reverse of this Quotation.

for and on behalf of
Hinopak Motors Limited,

Syed Muhammad Rehan
Branch Head - Karachi

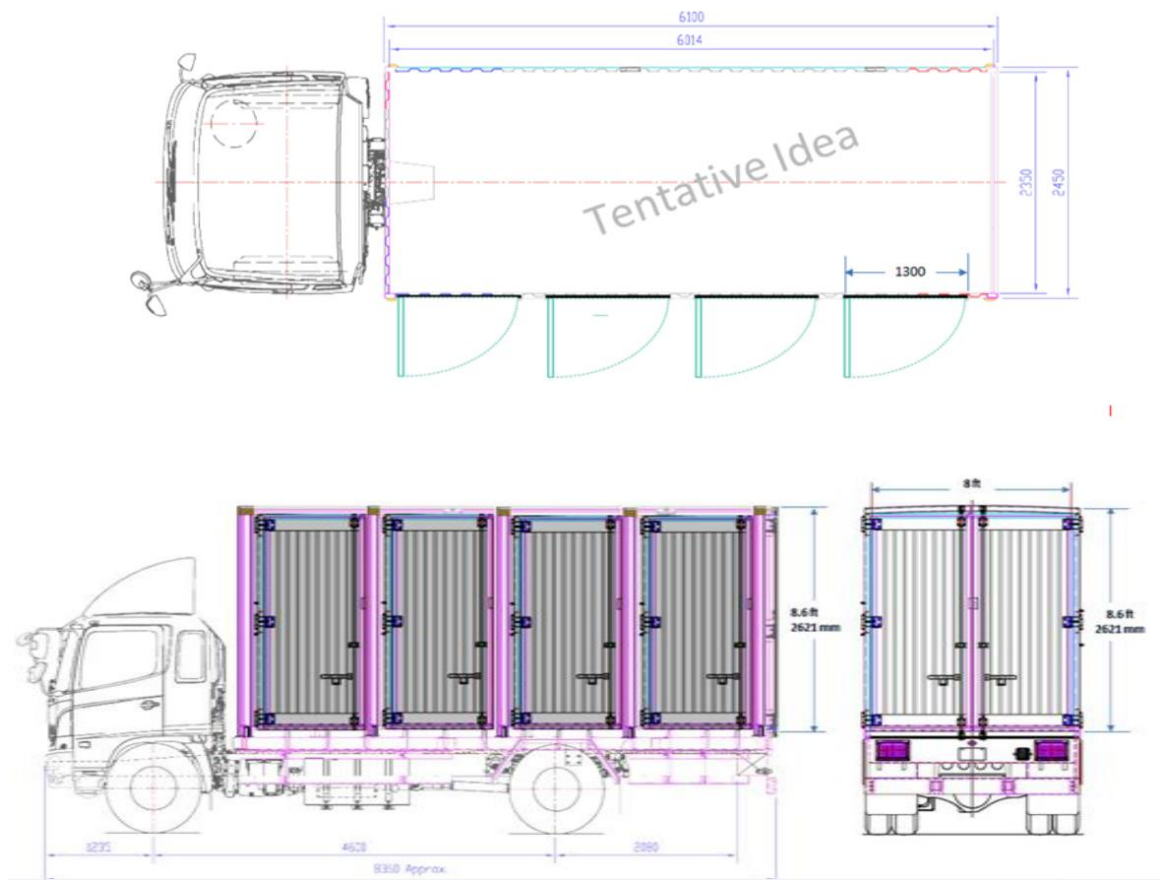
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MKT-SA/IV/006

Hinopak Motors Limited

Head Office: D-2, S.I.T.E., Manghopir Road, P.O. Box No. 10714, Karachi Tel: (021) 32563933, 32562485, 32563510-18 Fax: (021) 32564517, 32563028 email: marketing@hinopak.com Lahore: 19 km, Multan Road Tel: (042) 7512003-6 Fax: (042) 7512005 e-mail: hino-lahore@sat.net.pk Islamabad: 1-D, Unit 14 Rehmet Plaza, 2nd Floor, Blue Area Tel: (051) 2276234-5 Fax: (051) 2272268 e-mail: hino-islamabad@sat.net.pk Peshawar: Ring Road, Near Kohat Road Bridge, Peshawar Tel: (091) 2586004 Fax: (091) 2586005 e-mail: hino-peshawar@hinopak.com Quetta: Room No. 31, 32, 33, 2nd Floor AJ-Zain Center, Near City School, Zarghoun Road, Quetta Cell No. +92-305-2223351 e-mail: hino-quetta@hinopak.com Website: www.hinopak.com

12.2 Container



M/S. The Pakistan Academy of Engineering (PAE)
Karachi.

Subject: Quotation of Freight van body

Qty-01

A . Construction & dimensions

Freight van body on Hino FG8JKLB Truck Chassis	
Freight van body (20' long x 8' wide x 8' 6" high)	
Sub frame C channel	5'x2'.5"
Cross member 21 no. C Channel	4'x2"
Side wall with MS sheet	14 guage
Gate frame 2x1 MS Pipe with 2 x Rear and 4 on passenger side total 06 gates	16 guage
Gate outer frame MS sheet	14 guage
Pillars are with MS sheet	3 mm
Suspension strengthening with leaf springs	
Plain Floor with MS sheet	10 guage

B . Body Painting

2K Paint

C . Accessories

Mud guard, Side protection & Safeguard bumper MS sheet 2mm
Containers locks and hinges best quality container type
Wind deflector
Tool Box 16 Guage MS Sheet
Backside light safety grill 2x2 4 angles

Total Cost of Fabrication with modification.

Rs. 1,485,000

In words: One million four hundred eighty five thousand only.

Terms & Conditions:

- Price: The quoted price is Ex-works Karachi and exclusive of all Taxes presently applicable and based on current exchange rates. Any changes in Taxes/Duties/Levies, increase in price due to currency fluctuations during the validity of our offer and/or during currency of the contract, the same shall be to buyer's account. Company will charge extra amount for extra work.
- **Validity:** Our price shall remain valid for acceptance and placement for a period 07 days
- **Delivery Period:** Delivery will be made within 30 to 40 working days after signing the contract agreement and after receiving advance payment and chassis. Any delay due to act of State, War, Fire, Blockade of Ships, Public Holidays, Floods, Strikes, Curfews, Covid Lockdown, Power Failure, Earthquakes, Abnormal Climate Condition, Revolutions, Civil Commotion, Hostilities or invasions or such other conditions beyond our control shall discharge us from any late delivery penalty
- **Payment:** 100% advance payment
- **Force Majeure:** Force Majeure will be applicable

12.3 Solar Panel

www.jinkosolar.com

Jinko Solar
Building Your Trust in Solar

Tiger Pro 72HC

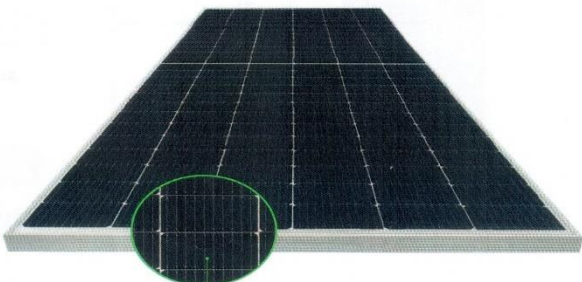
530-550 Watt

MONO-FACIAL MODULE

P-Type

Positive power tolerance of 0~+3%

IEC61215(2016), IEC61730(2016)
ISO9001:2015: Quality Management System
ISO14001:2015: Environment Management System
ISO45001:2018
Occupational health and safety management systems



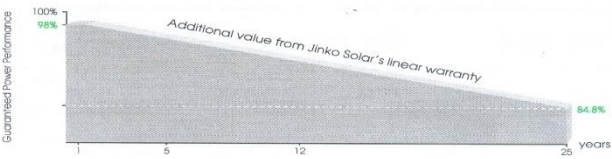
MBB HC Technology

Key Features

	Multi Busbar Technology Better light trapping and current collection to improve module power output and reliability.
	Reduced Hot Spot Loss Optimized electrical design and lower operating current for reduced hot spot loss and better temperature coefficient.
	Longer Life-time Power Yield 0.55% annual power degradation and 25 year linear power warranty.
	Durability Against Extreme Environmental Conditions High salt mist and ammonia resistance.
	Enhanced Mechanical Load Certified to withstand: wind load (2400 Pascal) and snow load (5400 Pascal).

 POSITIVE QUALITY™
Continuous Quality Improvement

LINEAR PERFORMANCE WARRANTY



Guaranteed Power Performance

100%
98%
84.8%

Additional value from Jinko Solar's linear warranty

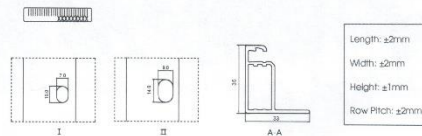
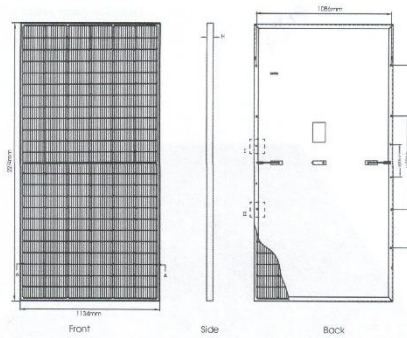
1 5 12 25 years

12 Year Product Warranty

25 Year Linear Power Warranty

0.55% Annual Degradation Over 25 years

Engineering Drawings

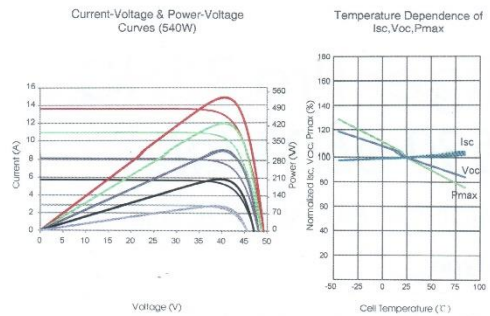


Packaging Configuration

(Two pallets = One stack)

31pcs/pallets, 62pcs/stack, 620pcs/ 40'HQ Container

Electrical Performance & Temperature Dependence



Mechanical Characteristics

Cell Type	P type Mono-crystalline
No. of cells	144 (6×24)
Dimensions	2274×1134×35mm (89.53×44.65×1.38 inch)
Weight	28.9 kg (63.7 lbs)
Front Glass	3.2mm, Anti-Reflection Coating, High Transmission, Low Iron, Tempered Glass
Frame	Anodized Aluminium Alloy
Junction Box	IP68 Rated
Output Cables	TUV 1×4.0mm ² (+): 400mm, (-): 200mm or Customized Length

SPECIFICATIONS

Module Type	JKM530M-72HL4		JKM535M-72HL4		JKM540M-72HL4		JKM545M-72HL4		JKM550M-72HL4	
	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Maximum Power (Pmax)	530Wp	394Wp	535Wp	398Wp	540Wp	402Wp	545Wp	405Wp	550Wp	409Wp
Maximum Power Voltage (Vmp)	40.56V	37.84V	40.63V	37.91V	40.70V	38.08V	40.80V	38.25V	40.90V	38.42V
Maximum Power Current (Imp)	13.07A	10.42A	13.17A	10.50A	13.27A	10.55A	13.36A	10.60A	13.45A	10.65A
Open-circuit Voltage (Voc)	49.26V	46.50V	49.34V	46.57V	49.42V	46.65V	49.52V	46.74V	49.62V	46.84V
Short-circuit Current (Isc)	13.71A	11.07A	13.79A	11.14A	13.85A	11.19A	13.94A	11.26A	14.03A	11.33A
Module Efficiency STC (%)	20.55%		20.75%		20.94%		21.13%		21.33%	
Operating Temperature(°C)	-40°C~+85°C									
Maximum system voltage	1000/1500VDC (IEC)									
Maximum series fuse rating	25A									
Power tolerance	0~+3%									
Temperature coefficients of Pmax	-0.35%/°C									
Temperature coefficients of Voc	-0.28%/°C									
Temperature coefficients of Isc	0.048%/°C									
Nominal operating cell temperature (NOCT)	45±2°C									

*STC: Irradiance 1000W/m² Cell Temperature 25°C AM=1.5
 NOCT: Irradiance 800W/m² Ambient Temperature 20°C AM=1.5 Wind Speed 1m/s

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 Specifications included in this datasheet are subject to change without notice.

JKM530-550M-72HL4-(V)-F1-EN



12.4 Inverter

SUN2000-3/4/5/6/8/10KTL-M0 Technical Specification

Technical Specification	SUN2000 -3KTL-M0	SUN2000 -4KTL-M0	SUN2000 -5KTL-M0	SUN2000 -6KTL-M0	SUN2000 -8KTL-M0	SUN2000 -10KTL-M0
Efficiency						
Max. efficiency	98.2%	98.3%	98.4%	98.6%	98.6%	98.6%
European weighted efficiency	96.7%	97.1%	97.5%	97.7%	98.0%	98.1%
Input						
Recommended max. PV power	6,000 Wp	8,000 Wp	10,000 Wp	12,000 Wp	14,880 Wp	14,880 Wp
Max. input voltage ¹			1,100 V			
Operating voltage range ²			140 V ~ 980 V			
Start-up voltage			200 V			
Full power MPPT voltage range	140 V ~ 850 V	190 V ~ 850 V	240 V ~ 850 V	285 V ~ 850 V	380 V ~ 850 V	470 V ~ 850 V
Rated input voltage			600 V			
Max. input current per MPPT			11 A			
Max. short-circuit current			15 A			
Number of MPP trackers			2			
Max. input number per MPP tracker			1			
Output						
Grid connection			Three-phase			
Rated output power	3,000 W	4,000 W	5,000 W	6,000 W	8,000 W	10,000 W
Max. apparent power	3,300 VA	4,400 VA	5,500 VA	6,600 VA	8,800 VA	11,000 VA ³
Rated output voltage			220 Vac / 380 Vac, 230 Vac / 400 Vac, 3W / N+PE			
Rated AC grid frequency			50 Hz / 60 Hz			
Max. output current	5.1 A	6.8 A	8.5 A	10.1 A	13.5 A	16.9 A
Adjustable power factor			0.8 leading ... 0.8 lagging			
Max. total harmonic distortion			≤ 3 %			
Features & Protections						
Input-side disconnection device			Yes			
Anti-islanding protection			Yes			
DC reverse polarity protection			Yes			
Insulation monitoring			Yes			
DC surge protection			Yes, compatible TYPE II protection class according to EN/IEC 61643-11			
AC surge protection			Yes, compatible TYPE II protection class according to EN/IEC 61643-11			
Residual current monitoring			Yes			
AC overcurrent protection			Yes			
AC short-circuit protection			Yes			
AC overvoltage protection			Yes			
Arc fault protection			Yes			
Ripple receiver control			Yes			
DC MBUS to optimizer			No			
General Data						
Operating temperature range			-25 ~ + 60 °C (-13 °F ~ 140 °F)			
Relative operating humidity			0 %RH ~ 100 %RH			
Operating altitude			0 - 4,000 m (13,123 ft.) (Derating above 3000 m)			
Cooling			Natural convection			
Display			LED Indicators; Integrated WLAN + FusionSolar App			
Communication			RS485;			
Weight (incl. mounting bracket)			RS485; WLAN/Ethernet via Smart Dongle-WLAN-FE; 4G / 3G / 2G via Smart Dongle-4G (Optional)			
Dimension (incl. mounting bracket)			17 kg (37.5 lb)			
Degree of protection			525 x 470 x 166 mm (20.7 x 18.5 x 6.5 inch)			
Nighttime Power Consumption			IP65			
			< 5.5 W			
Standard Compliance (more available upon request)						
Certificate			EN/IEC 62109-1, EN/IEC 62109-2			
Grid connection standards			G98, G99, EN 50438, EN50549-1, CEI 0-21, VDE-AR-N-4105, AS 4777, C10/11, ABNT, UTE C15-712, RD 1699, TOR D4, IEC61727, IEC62116, DEWA			

¹ The maximum input voltage is the upper limit of the DC voltage. Any higher input DC voltage would probably damage inverter.

² Any DC input voltage beyond the operating voltage range may result in inverter improper operating.

³ C10 / 11: 10,000 VA



Quotation

Name: Dr Jameel
Address: E -16, Block - 7, Gulshan E Iqbal

Ref No : OES-20216
Date : 11/05/2022

Item No	Description	Qty	Unit Price	Total
1	JINKO Solar 545W 25- Year Performance warranty 10 - Workmanship warranty	10	38,150	381,1500
2	Huawei Inverter 5kW 10 - Year warranty	1	220,000	220,000
			Subtotal	601,500
			Tax	17% GST Included
			Freight	-
			Total	601,500

Organic Energy Solutions (Pvt) Ltd
Suite 811. Anum Estate Buildind. Main Shahra e Faisal. Karachi.

12.5 De-ionized Water Plant



ITEM	MP10	MP20	MP30	MP40	MP60
Output	10L/H	20L/H	30L/H	40L/H	60L/H
Flow Rate	1.5-2L/min				
Feed Water Requirements	Tap water,temperature 10~35℃ pressure0.15-0.35Mpa TDS≤200mg/LRO water quality				
Conductivity(25℃)	2-10μs/cm				
Iron rejection rate	99%(new RO membrane)				
Organic rejection rate	>99%,when MW>200Dalton				
Particles and bacteria rejection rate	>99%				
Resistivity(25℃)	18.2MΩ·cm				
Bacteria	<1CFU/ml				
Particle	>0.22μm/ml<1μm/ml				
TOC	<3ppb				
AC requirement	110/220V,50/60Hz				
Dimension(L*W*H-mm)	410*300*500			500*400*750	
Weight(kg)	18	28	33	50	70



drnasimakhan@pacadengg.org

From: Mrs.Ivy Dai <service03@okayenergy.cn>
Sent: Thursday, June 23, 2022 7:54 AM
To: drnasimakhan
Subject: Re: Quotation for De-ionizer Plant

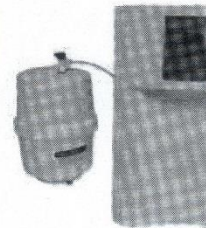
Dear Dr. Nasim A Khan,

Thanks for your reply.

Regarding to your requirements, our model OK-MP20 is highly recommended to you, here is the specification with quotation for your reference:

Model: OK-MP20
Unit price: USD1090/set EXW factory
Packing dimensions: 43*58*87cm
G.weight: 35kg

ITEM	MP10	MP20	MP30	MP40	MP60
Output	10L/H	20L/H	30L/H	40L/H	60L/H
Flow Rate	1.5-2L/min				
Feed Water Requirements	Tap water,temperature 10~35℃ pressure0.15-0.35Mpa TDS≤200mg/LRO water quality				
Conductivity(25℃)	2-10μs/cm				
Iron rejection rate	99%(new RO membrane)				
Organic rejection rate	>99%,when MW>200Dalton				
Particles and bacteria rejection rate	>99%				
Resistivity(25℃)	18.2MΩ·cm				
Bacteria	<1CFU/ml				
Particle	>0.22μm/ml<1μm/ml				
TOC	<3ppb				
AC requirement	110/220V,50/60Hz				
Dimension(L*W*H-mm)	410*300*500			500*400*750	
Weight(kg)	18	28	33	50	70



When will you need the machine?

Ivy Dai(Ms.) Sales ManagerOkay Energy Equipment Co., Ltd | +86-731-83979221 | +86 189 3245 1972

service03@okayenergy.cn <http://www.okayenergy.com> 2-102, No.100, Luyun Road, Changsha City, China

12.6 PEM Electrolyzer (Specifications)





SHANDONG SAIKESAISI HYDROGEN ENERGY CO., LTD
 TEL: + 0531-58795166 FAX: +86-531-58795199
 EMAIL: sales01@ql-spe.com MOBILE: +8618615696905
 ADD: NO.51 Gongyenan Road, High-tech Development Zone, Jinan, China

QL series PEM electrolyzer

From	SAIKESAISI HYDROGEN	Date	June 2022		
Model	Specification	Qty (set)	Price (USD)		Remark
			Unit	Total	
5000	-Max H2 flow rate:5LPM -Hydrogen purity:99.999% -Max Output pressure:7bar -Max Input power:about 2500w -Voltage :AC,220v, 50-60Hz -Torch screen display -Tech employed:Proton Exchange Membrane (PEM) Solid Electrolyte Maintenance-Free and Caustic-Free -Water tank capacity:3liter -Operating Environment:Indoor, non-classified, 40 ° F to 104 ° F (5 ° C to 40 ° C), < 80% RH, ventilated -Membrane type: DuPont Nafion PFSA Membranes -CE,ISO9001 standard	1	20600	20600	Asked water:Deionized, ASTM Type I , > 10 Meg Ohm-cm (< 0.1 microSiemen/cm)

Terms:

1. Country of origin: Shandong,China.
2. Packing: Airworthy packing
3. Trade terms: FOB Jinan
4. Payment term: TT/LC, 100% paid if amount no excess 20000USD.
5. Date of delivery: 25-45 working days according to machine model and Qty.
6. This quotation is valid within Four weeks since offered.
7. Above price is for region distributor only.

Product introduction:

The electrolyzer is used to generate 99.999% purity hydrogen gas which is widely used for all field which ask onsite continuous pure hydrogen. It is ideal equipment to replace dangerous hydrogen bottle. It adopt world-top PEM hydrogen tech to produce pure hydrogen by electrolysis pure water instead of traditional lye. So it is very environmental and user-friendly.

Application:

- ★ GC fuel gas and carrier gas
- ★ Chromatography make up gas
- ★ Gas analyzer support gas



SHANDONG SAIKESAISI HYDROGEN ENERGY CO., LTD
 TEL: + 0531-58795166 FAX: +86-531-58795199
 EMAIL: sales01@ql-spe.com MOBILE: +8618615696905
 ADD: NO.51 Gongyenan Road, High-tech Development Zone, Jinan, China

- ★ELCD (conductivity detector) reaction gas
- ★AED (atomic emission detector) of the reaction gas
- ★Other pure hydrogen application field
- ★Hydrogen supply for Hydrogenated oil

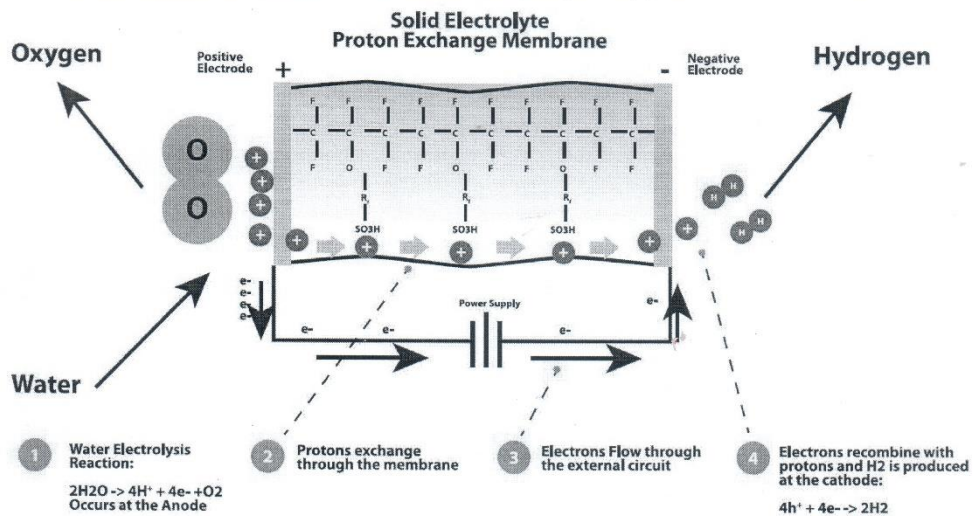
HOW PEM ON-SITE HYDROGEN GENERATION WORKS

Saikesaishi's hydrogen generation systems use a platinum catalyst and PEM (Proton Exchange Membrane) technology to split deionized water into its constituent parts.

The proton exchange membrane (PEM), which only allows water and positive ions to cross between compartments. The membrane also serves as the electrolyte in the cell, eliminating the need for hazardous liquid electrolytes such as concentrated potassium hydroxide. PEM water electrolysis simply splits pure deionized water (H₂O) into its constituent parts, hydrogen (H₂) and oxygen (O₂), on either side of this membrane. When a DC voltage is applied to the electrolyzer, water fed to the anode, or oxygen electrode, are oxidized to oxygen and protons, while electrons are released. The protons (H⁺ ions) pass through the PEM to the cathode, or hydrogen electrode, where they meet electrons from the other side of the circuit, and are reduced to hydrogen gas. The two reactions that occur in the cell are as follows:



4. Thus, the only possible components of the streams are hydrogen, oxygen and water moisture,



SPE/PEM Technology Advantages:

1. SPE technology---Solid Polymer Electrolyte



SHANDONG SAKESAI HYDROGEN ENERGY CO., LTD

TEL: + 0531-58795166

FAX: +86-531-58795199

EMAIL: sales01@ql-spe.com

MOBILE: +8618615696905

ADD: NO.51 Gongyenan Road, High-tech Development Zone, Jinan, China

2. The SPE electrodes, as the core of the product, are highly active catalytic electrode with nearly zero distance between the electrodes, which is formed by integrating composite catalyst with ion membrane with high electrolytic efficiency.
3. Plural-electrode and multi-unit electrolysis cell structure. Excellent chemical technological process properties of heat and mass transfer,
3. Electrolysis of pure water (no adding alkali) to produce high purity 99.999%) hydrogen with no corrosion and pollution.
4. Voltage of cell is low, electronic resistance in the electrolysis cell is little, could greatly saving energy. Circle time for changing desiccants is long.
5. Power consumption is less, electrolysis is efficient
6. Other parts of the generator are all produced by top-grade engineering plastics with superior quality.
7. Perfect electric control system. Stop working in emergency automatically.
8. Hydrogen Huge output, models are complete. Widely used in many industries
9. Got patent right, passed EU standard CE certificate, got top prize of BCEIA

Product Function Characteristics:

- (1) Electrolysis of pure water (without adding alkali) to produce hydrogen with no corrosion and pollution, and the purity of hydrogen is extremely high.
- (2) Cell voltage is low, purification of hydrogen is high, and cycle of changing desiccants is long.
- (3) Small electrolytic current, large output of hydrogen and voltage increasing quickly (3 to 5 minutes).
- (4) Hydrogenation is produced with stable pressure and output, output of hydrogenation can be controlled according to the requirements, and automatic control technology is perfect and reliable.
- (5) Stable hydrogen pressure, stable current output, track with the using hydrogen automatically, and credibly automatic protection technology when there are deauration, over-pressure and water-jet.
- (6) Little noise (the fan needn't to work when use the generator).
- (7) The electrolysis efficiency is high, and power consumption is less.
- (8) Excellent seal performance.

Typical customers

USA DIVERSIFIED WELL LOGGING LLC, SINOPEC JINAN REFINERY, SINOPEC SHENGLI OILFIELD, SINOPEC INTERNATIONAL PETROLEUM EXPLORATION AND PRODUCTION CORPORATION, SHAANXI COAL CHEMICAL INDUSTRY, QILU PHARMACEUTICALS, CHINA ATOMIC ENERGY RESEARCH INSTITUTE, BEIJING INSTITUTE OF TECHNOLOGY, DALIAN INSTITUTE OF CHEMICAL INDUSTRY, ITALY PROCHEMIA SRL, CHINESE ACADEMY OF SCIENCES, FIFTH INSTITUTE OF CHINA NUCLEAR, SPAIN UNIVERSIDAD POLITECNICA DE VALENCIA VALENCIA NANOPHOTONICS TECHNOLOGY CENTER, CHINA INSTITUTE OF ATOMIC ENERGY, OPTORUN (TAIWAN) CO., LTD, JIANGSU SKYRAY INSTRUMENT CO., LTD, CHINA



SHANDONG SAIKESASHI HYDROGEN ENERGY CO., LTD

TEL: + 0531-58795166

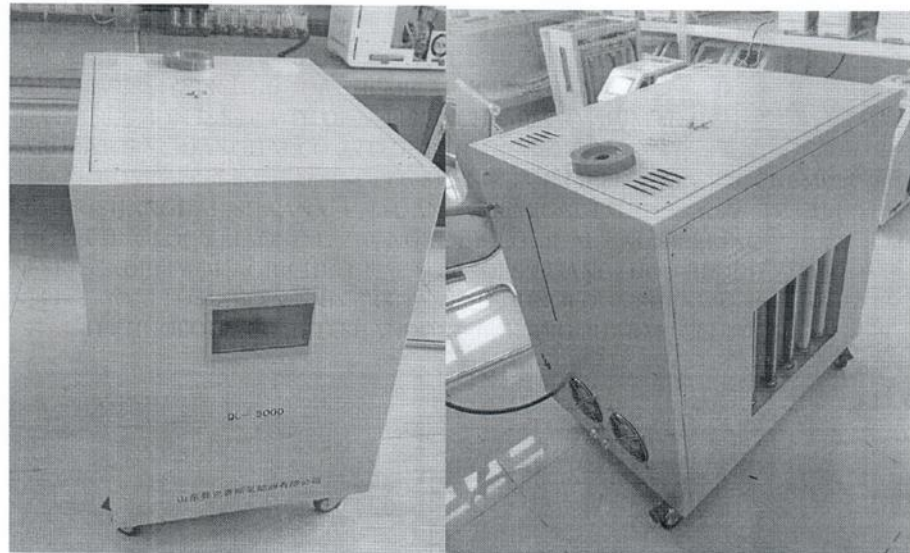
FAX: +86-531-58795199

EMAIL: sales01@ql-spe.com

MOBILE: +8618615696905

ADD: NO.51 Gongyenan Road, High-tech Development Zone, Jinan, China

NATIONAL NUCLEAR CORPORATION (CNNC), SPAIN UNIVERSIDAD POLITÉCNICA DE VALENCIA VALENCIA NANOPHOTONICS TECHNOLOGY CENTER, FOCUSED PHOTONICS INC., C.O. EAZE INC, SHELL ELECTRIC HOLDINGS LIMITED, QILU PHARMACEUTICAL, REPLETE TECHNOLOGY, PANNA INSTRUMENTS (CHANGZHOU) CO., LTD, TONGJI UNIVERSITY SCHOOL OF CHEMICAL SCIENCE AND ENGINEERING, CHANGCHUN INSTITUTE OF APPLIED CHEMISTRY, SHIMADZU RESEARCH LABORATORY (SHANGHAI) CO., LTD, GUILIN SANJIN PHARMACEUTICAL COMPANY LIMITED, SINOPEC SHENGLI OILFIELD, ITALY PROCHEMIA SRL, PERKINELMER (SHANGHAI), SHAANXI COAL AND CHEMICAL INDUSTRY, SOUTH CHINA UNIVERSITY OF TECHNOLOGY, LIAONING ZHONGKE BIOLOGICAL ENGINEERING CO., LTD, CHINESE ACADEMY OF AGRICULTURAL SCIENCES, GUANGZHOU BLUE MOON INDUSTRIAL CO., LTD, DALIAN UNIVERSITY OF TECHNOLOGY, SHENWU ENVIRONMENTAL TECHNOLOGY CO., LTD, SHANDONG LUKANG PHARMACEUTICAL CO., LTD



12.7 Fuel Cell



The Ballard FCgen H2PM 5.0kW fuel cell unit is a compact, modular power generator. It features a white metal casing with a large, square, perforated grille on the front face. The Ballard logo is visible on the grille. Below the grille, there is a control panel with a small digital display and several indicator lights. The unit is designed for 19-inch rack installation.

FCgen®-H2PM 5.0kW

The FCgen®-H2PM 5.0kW is an electric power generator that uses hydrogen as fuel and fuel cell technology to provide up to 5kW of reliable backup DC power on demand. The intended application of this system is backup power for critical power applications. The FCgen®-H2PM System continuously monitors the DC bus voltage in a standby mode and operates during power outages when the DC bus voltage drops to a customer defined set point.

The FCgen®-H2PM 5.0kW is designed for a 19" rack installation. The system can be delivered in two configurations: either as a standard solution with an ultracap module add-on for battery free backup, or with customer supplied batteries. Multiple FCgen®-H2PM 5.0kW Systems can be coupled in parallel for higher loads than 5.0kW (maximum 12 systems in parallel for up to 60kW output).

Features

- 12 yearly self test features integrated
- Instant backup in case of power outage - no delay
- Compact and modular solution
- Backup duration dependent on how much hydrogen is available
- Hydrogen storage divided in three strings emptying one at the time
- Light weight
- Very low noise
- No toxic waste
- Zero emissions

Configurations

- 19" rack mount
- Exhaust air must be directed to outside
- Can be configured in parallel with other modules to get higher capacity
- Can be installed in outdoor cabinets, shelters or similar solutions

Product Specifications

Specification	Value
Power Rating	5.0kW
Nominal Voltage	48 Vdc
Voltage Adjustable	48 to 55 Vdc or -48 to -55 Vdc
Voltage ripple	< 100mVpp @ 30MHz
Overall Size (WxDxH)	500 x 567 x 617 mm (19.69" x 22.32" x 24.17")
Product Weight	75 kg (165 lbs.)
Fuel Storage	External hydrogen cylinders
Fuel Connection	Valve Block with 3 inlet strings
Fuel inlet pressure	5 bar(g) (Ballard supplied pressure regulator)
Fuel Specification	Hydrogen (Grade 3.5 or higher)
Fuel Consumption	13.4 NLPM of hydrogen per kW
Fuel monitoring	Dry contact alarm when a fuel string is empty
Enclosure Material	Alu-Zink Coated Sheet Metal and Aluminum
Indoor Installation Environment	Pollution degree 2
Sound Level	50 dBA at 1 meter at 5kW
Temperature Range	-20°C to +46°C (-4°F to +115°F) Ambient Temperature (Process Air) 5°C to +46°C (41°F to +115°F) Room/Indoor Temperature
Relative Humidity	5%-95% Non-Condensing
Alarms	Dry Contacts
Parallel Operation	Up to 12 FCgen®-H2PM Systems can be operated in parallel for up to 60kW of power output
Start-Up Time	System provides seamless response to grid loss with DC bus battery or UltraCap Unit add-on
Standby Power	32W (DC) and 61W (AC & DC) including UltraCap option 0W to 200W (AC heater) Freeze Protection
AC Power Input	110/230 VAC (90-264 VAC) 50/60Hz
Certifications	CE
Alarms	Dry Contacts / SNMP via Eltek Smartpack S
Fuel Consumption	53.6 NLPM of hydrogen @ 4.0kW power output
Includes	Description
4001700	FC Unit, FCgen®-H2PM 5.0kW/48V
4001750	Controller, FCgen®-H2PM 5.0kW/48V
4000870	Valve Block, FCgen®-H2PM 5.0kW/48V



Jiangsu Ice-city Hydrogen Energy Technology Co.,Ltd

Industry Street, Yunyang Hi-tech Development Zone,
Dan Yang City, Jiang Su Province, PR China
+86-0511-86381660 +86 1337751650
hydrogen@icecity-js.com

Quotation

Date:Jul.14.2022

Validity: 30 days

Description	Quantity	Unit Price
2000w hydrogen fuel cell	1	\$17800
Relief valve	1	\$1550
12L hydrogen tank	1	\$1650
Total		\$21000

Remark:

- 1.The total price is not include the freight.
- 2.Payment term: TT full payment
- 3.Delivery time: In 30-40 working days after supplier receives the full payment
- 3.Shipping:International Express
- 4.Taxes have to be paid by customer.

Bank information:

Beneficiary:JIANGSU ICE-CITY HYDROGEN ENERGY TECHNOLOGY CO.,LTD

Account No.:502769097486

Swift Code:BKCHCNBJ95D

Bank Name:BANK OF CHINA, DANYANG SUB-BRANCH

Bank Address:NO.11 XINMIN ZHONG ROAD,DANYANG CITY,JIANGSU PROVINCE,CHINA

Note:

Our fuel cell usually includes a hydrogen fuel cell stack,a fan, an exhaust valve and a controller.

Since system requirement is atleast 5 kW Fuel Cell, therefore, a quantity of three 2000W fuel cells will be required.

12.8 Hot Water Tank



The water tank features are as follows:

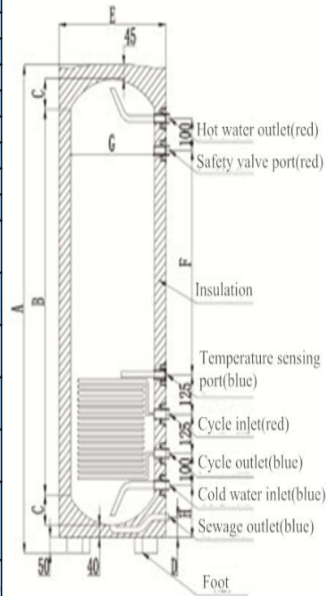
1. The tank liner is made of high quality food safety grade SUS304 stainless steel, which does not pollute the water.
- 2, using SUS316L built-in heat exchange coil, high heat exchange efficiency, corrosion resistance.
3. The inner tank adopts microcomputer automatic argon arc welding, and the special weld anti-corrosion treatment ensures the service life and greatly prolongs the service life.
4. The water tank capacity can be produced from 80L-1000L, and the customization is flexible.
- 5, the water tank insulation layer is made of high-density polyurethane insulation material, using German technology high-pressure foam once molding, the insulation effect is good.
- 6, the appearance is diverse, the shell has white color coated board, gold and silver VCM laminated board, stainless steel, suitable for different customer groups.
7. The water tank adopts pressure-bearing design to achieve constant pressure and constant temperature water supply, which is more comfortable to use.

Performance parameter

Liner material	Housing material	Housing color	Insulation Materials	Max. temperature	Design pressure	Detecting pressure	Coil detection pressure
SUS304(Standard) SUS316L(Customized)	Color coated board, VCM laminated board, 304 stainless steel plate	Pearl white, flash silver, champagne gold, 304 brushed	High pressure polyurethane foam (38Kg/m ³)	90℃	0.6 Mpa	1.2 Mpa	6.0 Mpa

Product Size

Model	100L	150L	200L	260L	300L	400L	500L
A	1115	1545	1545	1625	1915	1625	1915
B	790	1220	1170	1200	1490	1170	1460
C	95		120	145		160	
D	70						
E	470		520	560		700	
F	280	710	660	650	940	620	910
G	370		420	470		600	
H	165		190	235		250	
Coil parameter	φ9.52*25M			φ9.52*30M		φ9.52*40M	
Cold water inlet	DN15				DN20		
Hot water outlet	DN20						
Sewage outlet	DN15						
Tem.sensing port	φ9.5						
Negative pressure valve	DN15						
Dimension(mm)	φ470*1115	φ470*1545	φ520*1545	φ560*1625	φ560*1915	φ700*1625	φ700*1915



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[Add to Favorites](#)

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Verify

Zhengzhou Tong

Trading Company

CN 7YR

Response Time

≤6h

12.9 R.O. Plant for Drinking Water



Deals in all kinds of
Water Purification Products
& General Order Supplier



Ref.#: FT-DS/K-2022/0627

June 27, 2022

Attn.
Dr. Nasim A Khan
Executive Secretary
The Pakistan Academy of Engineering
Karachi - Pakistan
Cell # 0333-3362870
Email: drnasimakhan@pacadengg.org

SUB: PROPOSAL FOR SUPPLY OF RO+DI PLANT CAPACITY 1,500 US GPD

Dear Sir,

This is reference to our discussion today regarding your requirement of Water Reverse Osmosis Plant including Deiozer Filters having capacity of 1,500 US gallons per day; based on provided water TDS, we have worked out a state of the art RO plant fabricated with quality equipment.

We hope that our offer will be in line within your requirement, and if you feel any further assistance, please feel free to contact us.

We assure you our best services at all times.

Truly yours,

Regards

Azhar Rafique
0333-3399184
Sales & Technical Support

C-1, 1st Floor, Shazco Center, Opp. PIA Planetarium, Main University Road,
Gulshan-e-Iqbal Block 13-A, Karachi-Pakistan. Tel: +92 21-34830858
Email : finetech.water@gmail.com info@finetech.com.pk www.finetech.com.pk

QUOTATION
FOR
REVERSE OSMOSIS
& DE-IONIZATION PLANT

Capacity: 1,500 US Gallons per Day

A- GENERAL INFORMATION

Organization : The Pakistan Academy of Engineering

B- BASIC DESIGN DATA

Purpose	:	General Use
Feed Water Source	:	Boring Water
Feed Water TDS	:	$\leq 5,000$ mg/L
Feed Water Turbidity	:	≤ 5 NTU
Feed Water pH	:	6.5 – 8.5
Feed Water Design Temperature	:	10 – 45 °C
RO Recovery Rate	:	Up to 60%
Required Feed Water Flow	:	06 Gallons Per Minute
RO Permeate Water Flow Rate	:	0.75-01 Gallons Per Minute
RO Permeate Water TDS	:	< 135 ppm
Drinking Water TDS after minerals	:	< 150-250 ppm
DI Water Conductivity	:	< 0.1 μ S/cm
Type of RO Membrane	:	Thin Film Composite
RO Membrane Rejection Rate	:	98-99%

Note: Feed water must be FREE from heavy solid suspended particles like mud, clay, iron, zinc & etc.

C- MATERIAL SPECIFICATIONS

DESCRIPTION		QTY
FEED WATER PUMP Type: Horizontal (New) Material of Construction: SS-304 Power: 0.75 – 1.0 hp, Three Phase, 2900 rpm Make: CNP (China) or Equivalent		One Set
MULTIMEDIA SAND & CARBON FILTER Filter Vessel: Fiber Reinforced Polymer (FRP) Make: F-TECH/EuroTech (China) or Equivalent Dimension: 10 × 54 or equivalent Media: Graded Silica Sand & Gravel Max. Working Pressure: 150 psi		Two Sets
SLIM FILTER HOUSING Material Type: PVC Cartridge Housing Size: 20" Polypropylene Filament Cartridge Filter Filter Rating: 5 Micron Origin: China		Two Sets
R.O SKID FRAME Material Type: Mild Steel 18SWG, Powder Color Coated Origin: Fabricated in Pakistan		One Set
ANTISCALANT DOSING SYSTEM Dosing Capacity: 5 Liters per hour Working Pressure: up to 5 bar Make: Etatron Origin: Italy Tank Capacity: 80 Liters Material: Polyethylene (Food Grade) Make: Ayaan Tuff, Pakistan		One Set

R.O HIGH PRESSURE PUMP Type: Vertical Multistage SS-304 (New) Power: 2.0 hp, Three Phase, 2900 rpm Make: CNP (China) or Equivalent		One Set
MEMBRANE HOUSING / PRESSURE VESSEL Filament Wound Epoxy/Glass composite Size of vessels: 4" diameter x 1 Element Long End plug material: PVC With Aluminum Plate Operating Pressure: 300 psi Make: F-TECH/HOWELL or Equivalent Origin: China		One Set
R.O MEMBRANE ELEMENT Manufacturer: Toray USA or Equivalent Size of membranes: 4" diameter x 40" long Membrane Type: Polyamide Thin-Film Composite		One Set
MEMBRANE CLEANING AND FLUSHING SYSTEM With CIP tank of 80 Liters		One Set
ONLINE FLOW METER Panel Mount Flow Meters Flow Capacity: 0-5/10 GPM Origin: China		Two Sets
ONLINE PRESSURE GAUGES Type: SS liquid Filled Pressure Range: 0-25 bar Make: WIKA, ZYSA, ZY or Equivalent Origin: China or Equivalent		Three Sets
ONLINE TDS/ Conductivity METER For RO Product Water Range: 0-1,999 mg/L Make: Create Instrumentation or Equivalent Origin: China or Equivalent		Three Sets
RO CONTROLLER/ELECTRICAL PANEL Digital Volts Meters, Digital Ampere Meters, Manual Switch, Contractors with over loads, Phase Failure, Main & Control Breakers, ON /OFF Indication Lights etc. Origin: Imported		One Set
LEVEL/FLOAT VALVE Purpose: To control low level of feed water Brand: Huto (China) or Equivalent		One Set

PRODUCT (Drinking/DI) & FEED WATER TANK Capacity: 800-1000 Liters Brand: Ayan Tuff Pakistan		Three Sets
CAT-ION EXCHANGE FILTER Filter Vessel: Fiber Reinforced Polymer (FRP) Size: 10" x 54" Make: FTECH /EuroTech (China) or Equivalent Media: Strong Acid Cat-ion Exchange Resin (Rechargeable) Origin: Purolite / TRILITE / PURE China or equivalent		One Set
AN-ION EXCHANGE FILTER Filter Vessel: Fiber Reinforced Polymer (FRP) Size: 10" x 54" Make: FTECH/EuroTech (China) or Equivalent Media: Strong Base An-ion Exchange Resin (Rechargeable) Origin: Purolite / TRILITE / PURE China or equivalent		One Set
MIXED-BED POLISHING FILTER Filter Vessel: Fiber Reinforced Polymer (FRP) Size: 10" x 54" Make: FTECH/EuroTech (China) or Equivalent Media: Mixed Bed Ion Exchange Resin (Replaceable) Origin: Purolite / EZ Tech China or equivalent		One Set
DI MEDIA RECHARGE TANK Tank Material: Polyethylene (Food Grade Quality) Capacity: 20 Liters Make: Ayaan Tuff or as required		Two Sets
SOFTENER VALVE (Manual) Make: RUNXIN China or equivalent		Two Sets

MINERAL DOSING PUMP WITH TANK Dosing Capacity: 5 Liters per hour Working Pressure: up to 5 bar Make: Etatron Origin: Italy Tank Capacity: 80 Liters Tank Material: Polyethylene (Food Grade) Make: Ayaan Tuff, Pakistan		Two Sets
FILLING PUMP Model: SGJ-800 Make: Taifu Origin: China		One Set
COMPLETE PVC FITTING With PVC Piping, Sch 80 Fitting Brand: HYDROPLAST (Pakistan) or equivalent		Complete Set

TERMS AND CONDITIONS

PRICES & PAYMENT

Price includes Reverse Osmosis System with Pre-Treatment, CIP System and Deionizer will be:

Rs. 950,000/- Ex. Karachi

(Pak Rupees Nine Hundred & Fifty Thousand Only)

Price EXCLUDING all applicable tax (CASH PRICE)

PAYMENT TERMS

- 75% advance payment with confirmed purchase order
- 20% at the time of delivery of complete plant at your site
- 05% within 15 days after successful Installation and Commissioning

TERMS & CONDITIONS

DELIVERY SCHEDULE

We undertake to deliver the plant within 10 to 20 days after receiving your confirmed purchase order and advance payment. All Goods shall be properly packed to protect the contents against damage through transportation to the Site.

RESERVE:

We reserve the right to make proper modifications in order to improve the productivity where it is required.

CLIENT'S RESPONSIBILITIES

- Civil work, if any
- Electricity supply to the plant panel in the plant room
- Feed water supply to raw water storage tank in the plant room
- Product water pipe work out of the Plant room, if any
- Drain and backwash water pipe work outside the room, if any
- Any item or service which is not specified in our offer

SUPPLIER'S RESPONSIBILITIES

- To install & commission the plant
- To guarantee the desired quality & capacity of plant
- To provide after sales service on cost if required
- To supply spares on cost in case of requirement

VALIDITY

Our offer is valid for 15 days from the date of issue unless previously withdrawn.

WARRANTY & AFTER SALE SERVICE

WARRANTY

All equipment supplied by FineTech is guaranteed against defective manufacture and bad workmanship for 03 months from the date of commissioning. This warranty does not apply to damage resulting from incorrect or negligent operation or maintenance of equipment electrical or physical damage, damage due to excessive temperature, normal wear and tear alterations or repairs not authorized by us.

TRAINING:

The necessary training will be provided to the technicians / engineers / operators for daily operations and routine maintenance of the complete system.

We hope you will find the above in line with your requirements and will intimate us of your further interest shortly. Please feel free to contact us for any clarifications & further information.

With Best Regards



Azhar Rafique
Sales & Technical Support
0333-3399184

12.10 Hydrogen Tank

High pressure hydrogen storage tank coupled with compressor will be used for hydrogen storage.



Composite Cylinder (Tensile strength of the material = 2000 MPa)

Working Pressure = 350 bar

Mass of hydrogen = 55.8 kg

Diameter of Tank = 1 m

Length of the Tank = 3 m



Hydrogen Ionic Compressor

12.11 Hydrogen Sensor

MQ-8 hydrogen gas sensor of high sensitivity. The monitoring of the other hydrogen-containing gas is also very satisfactory. This sensor can detect a wide range of hydrogen gas, city gas, in particular, is a low-cost sensor for a variety of applications.

Module Applications:

Suitable for home or industrial hydrogen leakage monitoring devices. Can not interfere with ethanol vapor, soot, carbon monoxide and other gases.

Features:

1. Using high-quality dual-panel design, with power indicator and TTL signal output instructions.
2. The switching signal having a DO (TTL) output and analog output AO.
3. TTL output valid signal is low. (Low-level signal when the output light can directly connect to the microcontroller or relay module)
4. The higher the voltage, the concentration of the analog output voltage is higher.
5. A hydrogen gas detection with good sensitivity.
6. There are four screw holes for easy positioning.
7. Product dimensions: 32 (L) * 20 (W) * 22 (H)
8. Has a long life and reliable stability.

Specifications:

Input voltage: DC5V Power consumption (current): 150mA

DO output: TTL digital 0 and 1 (0.1 and 5V)

AO output: 0.1-0.3 V (relative to pollution), the maximum concentration of a voltage of about 4V

Type Here

1 item(s) for Price=220

Home / Arduino Modules Components / Sensors & Modules / Sensors / MQ8 Hydrogen Gas Sensor Module in Pakistan

76 of 132



MQ8 Hydrogen Gas Sensor Module in Pakistan

China



1 review

Write a review

Price=220

SKU: B218,IMP100,Th50,A

Availability: In stock

Quantity: 1

12.12 Exhaust Fans

Home Appliances

Cooling & Heating

Exhaust Fans

Exhaust Fan 12 inch Metal Body - IN/OUT Double Action - 100% Pure Copper Winding



Exhaust Fan 12 inch Metal Body - IN/OUT Double Action - 100% Pure Copper Winding

★★★★★ 3 Ratings 3 Answered Questions

Brand: No Brand More Cooling & Heating from No Brand

Rs. 2,999

Quantity: 1

Buy Now

Add to Cart

Delivery

Sindh, Karachi - Gulshan-e-Iqbal, Block 15

Standard Delivery
3 - 7 day(s)

Cash on Delivery Available

Service

7 Days Returns
Change of mind is not applicable

Warranty not available

Sold by

Ittefaq Trading

Positive Seller

Ratings

93%

Ship on Time

98%

Cha Rate

95%

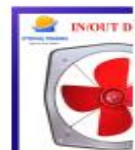
Visit Store

Product details of Exhaust Fan 12 inch Metal Body - IN/OUT Double Action - 100% Pure Copper Winding

- 12 inch Blade Size
- IN/OUT Rotation (Double Action)
- 100% Pure Copper Winding
- Body Size: 14.5x14.5 inches
- High Speed Exhaust Fan

- Heavy Duty Metal Body
- Energy Efficient
- Long Lasting Motor
- Operating Voltage 220V - 240V

From The Same Seller



Exhaust Fan 12 inch Metal Body - IN/OUT Double Action - 100% Pure Copper Winding

Rs. 2,999

★★★★★

3 Ratings

3 Answered Questions

More Cooling & Heating from No Brand

Brand: No Brand

Operating Voltage 220V - 240V

Energy Efficient

Long Lasting Motor

High Speed Exhaust Fan

100% Pure Copper Winding

12 inch Blade Size

IN/OUT Rotation (Double Action)

Body Size: 14.5x14.5 inches

Heavy Duty Metal Body

Energy Efficient

Long Lasting Motor

Operating Voltage 220V - 240V

Energy Efficient

Long Lasting Motor

Operating Voltage 220V - 240V

Energy Efficient

Long Lasting Motor

Operating Voltage 220V - 240V

Energy Efficient

Long Lasting Motor

Operating Voltage 220V - 240V

Energy Efficient

Long Lasting Motor

Operating Voltage 220V - 240V



Quantity required = 4 (Pcs)

12.13 Stove/Grill

Campingaz Party Grill stove offers unlimited cooking options. It is a compact stove that is portable, lightweight and easy to carry. This innovatively designed stove allows you to enjoy multiple cooking options. Also, the detachable element of the BBQ grill can easily be stored inside the device. The detachable legs and removable lid can easily be used and stored. Party Grill 200 runs on the removable gas cartridge that can be disconnected when not in use and reconnected when needed. This compact and portable stove offers you multiple cooking options. Choose from a grilling grid or stovetop to make all your favorites or simply a nice cup of tea. All elements of the Party Grill can fit inside the device. Thanks to its detachable legs and lockable lid, it is easy to transport and store. The piezo ignition promises simple, match free lighting wherever you are.

FEATURES:

Gas consumption:145 g/h

Cooking time:4 min 18 sec

Weight:2.84 kg

Dimensions (LxWxH):32 x 33 cm

