BAHRAIN SOCIETY OF ENGINEERS

ALMOHANDIS

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Alba's Power Station 5 Block 4 Project.. Pioneering Sustainable Industrial Growth in Bahrain

A Journey with Engineer Hesham Zubari

ALMOHANDIS

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Speech of the Editor-in-Chief

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ALMOHANDIS

This issue of Al Mohandis focuses primarily on the petroleum sector. It begins with a feature story following an engineer's journey in the field, accompanied by several articles related to the same industry. Additionally, it highlights a young engineer currently working at a petroleum company.

In this issue, Al Mohandis Magazine features a prominent figure in the industrial sector, particularly in the field of oil and gas. The guest began his career as a petroleum engineer in the Kingdom of Bahrain nearly forty years ago and steadily rose through the ranks to become the Deputy CEO of Tatweer Petroleum and a Senior Advisor at the Ministry of Oil. He continued his professional journey in the United Arab Emirates, where he held leadership positions at Dragon Oil in Dubai, including Head of Artificial Intelligence and Innovation, followed by Head of Technology and Field Development. He is the first Bahraini to be elected to the Board of Directors of the Society of Petroleum Engineers (SPE) representing the Middle East and North Africa region for the term 2022–2024—an achievement that highlights his leadership and excellence. The featured guest has an outstanding record of participation in regional and international conferences and has received prestigious awards, including the SPE Regional Award and an honorary doctorate. He has also been recognized as one of the most influential leaders in the Arab world. He believes that humility, integrity, innovation, and artificial intelligence are the foundations of the future of engineering. Our featured personality is Engineer Hesham Zubari.

In recent years, the Kingdom of Bahrain has embarked on an ambitious journey towards sustainability and environmental stewardship. This commitment is epitomised by the National Action Plan to achieve Carbon Neutrality for ALBA. This is the profile of the present issue of Al Mohandis is the PS5 Block 4 is a new 680.9 MW combined-cycle power plant that expands the PS5 facility's total capacity from 1,800 MW to 2,481 MW, boosting Alba's energy self-sufficiency and reliability. It features Mitsubishi Power's hydrogen-ready M701JAC gas turbine, known for high efficiency and lower emissions. The project was a collaboration among Mitsubishi Power (turbine supply and engineering), SEPCOIII (EPC contractor), and ESB International (ECM consultancy).

Engineer Ebrahim Al-Burshaid in his article titled "Drones: Their Importance, Origins, and Application Potential," discussed the significance of utilizing drone data to provide integrated solutions for topographic surveying, aerial mapping, and cartography through remote sensing systems and geographic information systems (GIS). He highlighted that drones are equipped with payloads capable of capturing high-resolution imagery with spatial accuracy measured in mere centimeters, efficiently, quickly, and at lower costs. He concluded by stating that drone technology is among the latest advancements that have transformed various aspects of both military and civilian fields. The Kingdom of Bahrain is well-positioned to greatly benefit from this technology, given its low cost, high efficiency, and vast applications across multiple sectors.

The corrosion of tanks, pipelines, units, and metal equipment in the oil and gas sector poses a major challenge for chemical engineers due to the significant costs associated with corrosion, including production losses, reduced efficiency, and the expenses of replacing corroded equipment and implementing various protection methods. In his article, Dr Husni Al_Zubair addresses in his article entitled "Corrosion Resistance in Industrial Sectors" the challenges and limitations in combating the corrosion of metal structures. Despite the application of various protection technologies, these strategies cannot be considered a definitive solution to prevent the failure of metal structures. Furthermore, certain factors must be considered to avoid jeopardizing corrosion prevention efforts.

In his article entitled "Floating Photovoltaic Systems: A Game-Changer for Aqua Hydrogen

Production in Bahrain", Dr. S. M. Zakir Hossain emphasizes that using floating photovoltaic (FPV) systems on seawater in Bahrain represents a groundbreaking step toward sustainable energy by enabling hydrogen production through seawater electrolysis. This innovative approach combines two emerging renewable technologies-floating solar power and green hydrogen production-forming a promising new industry. By leveraging its abundant solar resources and embracing advanced technologies, Bahrain has the potential to position itself as a leader in the green hydrogen revolution. The integration of FPV with electrolysis could significantly reduce carbon emissions, enhance energy security, and support economic diversification in the Kingdom. This model could also serve as an example for other nations facing similar sustainability challenges.

Engineer Hani Al-Khayat in his article entitled "Turnaround and Inspection (T&I) Shutdowns in Oil and Gas Plants – Challenges and Solutions" deals with the challenges in Turnaround and Inspection shutdowns in oil and gas plants are really complicated, serious and hectic which needs smart planning, intense coordination, close follow-up, knowledge, full understanding (expertism) and execution capabilities. Addressing and understanding challenges in Turnaround and Inspection shutdowns professionally is dynamic. Overcoming challenges is integration of multi discipline and expertism to transform the plan of shutdown to a fact on ground and success.

We must also highlight on the young engineer, Mohammed Abdulameer Mubarak, who works in the Engineering & Technical Department at Bapco Gas, in the oil and gas sector. Through his activities, he contributes to the activities of the BSE, as he has been a member of several committees, including the Membership Committee, the Conferences Committee, and Social Activities Committee.

Three students; Ali Alrosani, Murtadha Jawad, and Amjad Saleh under the supervision of Dr.Raja Mohammed Sumsudeen worked on their senior project entitled "Design and Development of a Sensor-Based Low-Cost Drowning Detection System for Human Life Safety". The project aims to investigate and implement the most effective sensor technologies, reduce false alarms through intelligent algorithms, and integrate these technologies in a manner that ensures user safety and privacy. By providing real-time alerts and initiating rescue protocols, the system minimizes the risk of drowning accidents and offers a robust solution for both public and private swimming pools.

Belal Mohammed, Taher Mohmmad, and Wujood Hassan under the supervision of Professor Mohab Mangoud worked on their senior project entitled "Smart Water Management System for Home Plants". The Smart Home Water Management System is an innovative solution designed to optimize plant care by automating the irrigation process based on real-time environmental data. Through their integration of Internet of Thing and automation, the project aims to streamline plant management, improve resource efficiency, and contribute to a sustainable, ecofriendly living space.

The senior project titled "Design of a Power-Assist Device (PAD) for Manual Wheelchairs" was undertaken by students Mohamed Nooh, Ahmed Abdulsalam, Abbas Saeed, and Qasim Hasan, under the supervision of Dr. Salwa Baserrah. This project focuses on the design and development of an electric add-on device that can be easily attached to a standard manual wheelchair, effectively converting it into an electric-powered tricycle. Referred to as a Power-Assist Handcycle, the device integrates ergonomic design, robust engineering, and intuitive controls to offer a versatile and cost-effective mobility solution.

The senior project titled "Smart Inflatable Life Jacket for Child Safety and Swimming Learning" was conducted by students Abdulla Ali, Husain Fadhel, and Sayed Abdulla Ismaeel, under the supervision of Dr. S. Ali Al-Mosawi. This project addresses the pressing need for innovative solutions to enhance child safety in aquatic environments while supporting swimming education as an essential life skill. Traditional life jackets often impede swimming instruction by keeping children constantly buoyant, which prevents effective practice of swimming techniques. This project marks a significant advancement in leveraging modern technology to address real-world safety challenges in a practical and efficient manner.

A Journey with an Engineer

Engineer Hesham Zubari

Chief Technology & Field Development Officer, Dragon Oil

In the present issue of Al Mohandis Magazine, we host a distinguished figure who has left a remarkable mark in the industrial sector, particularly in the field of oil and gas.

Our guest has steadily climbed the professional ladder since beginning his career as a petroleum engineer in the Kingdom of Bahrain nearly forty years ago, eventually becoming the Deputy CEO of Tatweer Petroleum, as well as the Senior Advisor at the Ministry of Oil.

He continued his professional journey in the United Arab Emirates, where he held the position of Head of Artificial Intelligence and Innovation, then Head of Technology and Field Development at Dragon Oil in Dubai.

Our guest is the first Bahraini to be elected to the Board of Directors of the Society of Petroleum Engineers (SPE) representing the Middle East and North Africa (MENA) region for the 2022-2024 term - an achievement that reflects his excellence and leadership.

He also has a distinguished record of professional participation in specialized conferences at both regional and international levels, including in Bahrain, the Gulf states, Central Asian countries, and the United States.

He has received prestigious awards, including the SPE Regional Award and an honorary doctorate, and has been recognized as one of the most influential leaders in the Arab world. He believes that humility, integrity, and innovation—along with a focus on artificial intelligence—are the fundamental pillars for building a bright engineering future.

Eng. Hesham Zubari, welcome as a distinguished guest in the 82nd issue of Al Mohandis Magazine.

Can you briefly introduce your upbringing and early education?

I was born and raised in Manama, the capital of the Kingdom of Bahrain, in a household that placed a strong emphasis on education, ethics, and community service. I was fortunate to grow up in a family of engineers, scientists, artists, and athletes—thanks to parents who laid a strong foundation rooted in giving back to society. Growing up in such a vibrant and culturally diverse environment nurtured my curiosity and instilled an early love for science and literature. Living near the Ministry of Education's library further fuelled my passion for reading.

I completed my education in Bahrain, consistently ranking among the top-performing students, especially in mathematics, physics, and chemistry. At the age of 16, I enrolled at the University of Texas at Austin. I owe much to my high school teachers, whose encouragement and dedication played a pivotal role in shaping my academic trajectory. Their passion made us fall in love with the sciences that laid the groundwork for my engineering journey.

The Cambridge graduation ceremony, "Chief Technology and Innovation Certification Program Graduation Ceremony".

Why did you choose to study engineering, specifically petroleum engineering?

My decision to pursue petroleum engineering was rather unforeseen. After graduating from Al Hoora Secondary School with the 9th highest score in Bahrain, I received a number of scholarship offers. I ultimately chose a scholarship from the Bahrain National Oil Company (Banoco), based on my academic achievements. My elder brother, Dr. Waleed Zubari, who was a geologist at the time, introduced me to the field and encouraged me to apply.

I vividly recall Dr. Hassan Fakhro, then CEO of Banoco, personally meeting and encouraging us before we left for our studies in the U.S. He even sent us handwritten letters during our time abroad—a gesture that reflected the leadership style of the time.

Once I began my studies, I was immediately drawn to reservoir simulation. The idea of mathematically modelling subsurface reservoirs to predict production behaviours felt like uncovering the Earth's hidden language. I became passionate about applying science to solve real-life reservoir problems.

During high school, were you influenced by any engineering figure who shaped your path toward petroleum engineering?

Yes, I was influenced by Dr. Mustafa Al Sayyed and Dr. Hassan Fakhro, both pioneers in Bahrain's engineering landscape and close to our family. Their leadership and accomplishments inspired many, including myself. However, I was equally inspired by my father, Khalil Zubari—a school principal, artist, and calligrapher—who instilled in us a passion for knowledge and discipline. My mother, an avid reader, created an environment conducive to learning and growth around us and continuously encouraged us to pursue knowledge and education.

SPE Distinguished Lecturer Program hosted by Bapco in 2005.

As one of the early Bahrainis to study petroleum engineering in the U.S., how would you describe the university experience?

Attending the University of Texas at Austin in 1981, one of the world's top petroleum engineering institutions, was a transformative chapter in my life. The cultural shift from Manama to a major U.S. university presented both challenges and growth opportunities. Those early adaptation struggles ultimately shaped my perseverance and outlook.

I formed lasting friendships with international peers, and the academic rigor broadened my intellectual horizons. I was particularly captivated by how mathematics and science were applied to solve petroleum engineering problems—especially reservoir simulation. I recall spending long hours writing Fortran codes on punch cards and walking 30 minutes to the university's sole computer lab to run simulations. One of my proudest achievements was successfully writing a basic gas reservoir simulator in 1986 that accurately modelled fluid behaviour.

Beyond academics, the experience instilled in me the values of collaboration, critical thinking, and respect for aspiring students working hard to build their futures.

Upon returning to Bahrain, how did your career in the oil and gas sector begin? Please share an overview of your roles.

I began my career as a reservoir simulation engineer, developing predictive models to optimize oil and gas production. This technical foundation guided my progression into broader roles, from field development to strategic advisory positions.

One of the highlights was contributing to the establishment of Tatweer Petroleum in 2009. I was a member of the national negotiation team led by H.E. Dr. Abdul Hussain Bin Ali Mirza, the Minister of Oil at the time. After a year of intense negotiations with both Occidental Petroleum and Mubadala Petroleum, a $12 billion joint venture was formed, transforming Bahrain's field into a digital oilfield and raising production to a

Board of Directors of Tatweer Petroleum meeting, 2013.

peak of 55,000 bopd, and preparing a layer of Bahraini professionals in the process.

As Deputy CEO of Tatweer Petroleum and later Senior Advisor at the Ministry of Oil, I led Bahrain's first Guaranteed Energy Performance Contracting pilot project which cut energy use by 30% across 4 government facilities, saving millions and conserving gas, and showcasing the economic feasibility of the business model.

Today, I serve as Chief Technology and Field Development Officer at Dragon Oil, continuing to align technology, people, and policy to drive meaningful impact.

You were the first Bahraini ever to serve as a member of the Board of Directors of the prestigious International Society of Petroleum Engineers (SPE-I). Describe your experience.

Serving as the 1st Bahraini on the SPE International Board was a humbling honour after 36 years of technical community service. As the Regional Director for the MENA region, I had a unique platform to shape the energy dialogue across a vital hydrocarbon-producing region.

During my tenure, I introduced AI-focused competitions, expanded young professionals' involvement in regional conferences, and enhanced collaboration between academia and industry. I was also instrumental in launching the SPE Turkmenistan chapter.

It was in 2002, when Mr. Faisal Al Mahroos engaged a group of engineers, including myself, to establish a local SPE section in Bahrain. It became a cornerstone for knowledge sharing and professional growth. The section is still operational with members elected on regular basis to bring in a culture of engagement and ownership among all SPE members.

What I valued most was mentoring the next generation. I championed inclusion, diversity, and volunteerism within SPE, giving back to a community that once mentored me.

Dinner hosted by HE Dr. Mustafa Al Sayed on the occasion of holding the first "Women in the Oil and Gas Industry " workshop along side MEOS, 2006.

You've led many conferences, including GOTECH 2025 in Dubai. How do you evaluate the experience of organizing specialized exhibitions in Bahrain and the region?

Organizing GOTECH 2025 and other conferences has been a responsibility and privilege. These events are more than showcases—they are platforms for knowledge exchange, youth engagement, and regional collaboration.

Built by visionary leaders like Mr. Ali Rashid Al Jarwan and Mr. Fareed Al Hashimi at Dragon Oil, GOTECH is growing to be a reputable global event. The event is strategically positioned among major SPE events in the area to add value to both the members and the community.

The Gulf region has seen impressive growth in conference quality and scale. Bahrain's MEOS and GEO events now merged into one reflect this evolution. To ensure sustainability and impact, organizers must innovate and avoid redundancy, while fostering collaboration across stakeholders. This requires teamwork and commitments by all.

Could you tell us about your participation in the 2025 Energy Management Conference organized by the Bahrain Society of Engineers and the paper you presented?

At the kind invitation of the Bahrain Society of Engineers, Engineer Majeed Al Gassab, and Dr. Raida Al Alawi, I presented a paper titled "Leveraging Digital Transformation to Achieve Operational Excellence and Sustainability in Energy Operations." I shared real-world AI applications in oil, gas, and energy, emphasizing their role in predictive maintenance, emissions reduction, and decision-making.

I stressed that digital transformation is not a buzzword—it is a structured journey that requires leadership, investment, and cultural alignment. I also discussed the impact of rare earth minerals in shaping the future energy landscape and geopolitics and how can oil and gas companies navigate the complex unfolding energy landscape.

INSEAD Executive Roundtable on " The Technology Bridge to a Low Carbon Future" - Dubai 2022.

Executive Plenary Session at Oil and Gas Turkmenistan (OGT) 2025.

How would you assess the Bahrain Society of Engineers' organization of the 2025 Energy Management Conference and its accompanying exhibition?

The Bahrain Society of Engineers delivered a well-organized, impactful event but most importantly, a timely theme. The diversity of topics and quality of speakers reflected the event's relevance. I was honoured to contribute and share insights with Bahrain's engineering community.

The Society is healthy and continues to play a vital role in Bahrain's professional development landscape.

The SPE Annual MENA Regional Awards Ceremony, Al Khobar, 2022.

The Annual GOTECH 2024 University Students Program, Dubai, 2024.

At BSE's Energy Management Summit, Bahrain, 2025.

How do you evaluate the Society's role in advancing the engineering profession, particularly petroleum engineering, in Bahrain?

The Bahrain Society of Engineers has long been a pillar of the engineering community. Its programs—from certifications to technical forums—support knowledge dissemination and networking. Its youth engagement initiatives ensure Bahrain remains a source of top-tier engineering talent.

By staying attuned to emerging trends like AI, ESG, and energy transition, and by forging partnerships with global societies such as SPE, IEEE, and NACE, the Society is positioning itself as a progressive and inclusive force in regional development.

What are some of the key recognitions you've received professionally or socially?

I am proud to have received the SPE MENA Regional Award in 2021 and, more recently, an Honorary Industrial Doctorate from the International Maritime Club in partnership with the European International University in 2023. I was also recognized by Arabian World Magazine in 2024 as one of the most influential Arab energy leaders of the year.

Two milestone I hold dear were 1. organizing the first-ever Oil & Gas Marine Operations Excellence Workshop in the MENA region at GOTECH 2025 through SPE, a commitment that I made to the community during my tenure as SPE Board member, and 2. Attaching an AI-Hackathon to an SPE event, GOTECH, something I have always dreamed of achieving.

Still, the most meaningful recognition comes from colleagues and students who seek my guidance and mentorship. Their trust is the highest honour.

With your many public sector roles, what have you contributed to the sector, and what have you personally gained?

In the public sector, I focused on institutional capacity building, innovation, and enabling local talent. Initiatives like Tatweer Petroleum created jobs and technological advancement. Projects such as Al Hunayniya Oasis and the Guaranteed Energy Saving Pilot Project showcased sustainable innovation.

The GOTECH 2025 Technical Program Committee.

Personally, I gained invaluable insights into diplomacy, systems thinking, and the intricate link between policy and technical execution, especially with the Guranteed Energy Saving Pilot Project that required close coordination among 8 different ministries. These lessons have shaped my leadership philosophy and reinforced my commitment to serve at all levels.

After over four decades of professional contributions, could you share standout experiences that you consider the highlights of your journey?

I have plenty of experiences, but the 3 closest to my heart were the following.

Establishing Tatweer Petroleum as a JV between US-based Occidental Petroleum and UAE-based Mubadala Petroleum stands out as a defining milestone. The $12 billion joint venture revitalized Bahrain's oil and gas sector, created jobs, and developed a generation of Bahraini professionals. Unfortunately, the JV was cut short in 2017 due to the low oil prices, following $4 Billion investments in the Bahrain field.

Another highlight was being voted for on an international level to sit on the Board of Directors of International Society of Petroleum Engineers was a huge recognition on a global level. And furthermore, being the 1st Bahraini ever to serve as SPE MENA Regional Director enabling me to contribute to the region on a global stage, was a major milestone.

Finally, being awarded and Honorary Ph.D. by the International Maritime Club (IMC), was a major highlight in my career that showcased the value of serving not only the Oil and Gas community but also the technical communities around it, such as the Marine sector in this case.

Finally, what message or advice would you like to share with young engineers across all disciplines?

To young engineers: Stay curious, stay humble, and stay committed and focus on Artificial Intelligence in your studies. Beware of the traps of arrogance and hubris. Engineering is about solving real problems that affect real people. Embrace lifelong learning, seek mentorship, and take smart risks. Let integrity, resilience, and purpose guide your journey. You are not just shaping your career—you are shaping the world so lead with purpose and think international with the ultimate intention to serve your country.

At BSE's Energy Management Summit, Bahrain, 2025.

EGYPES 2025 Executive Plenary Session on Sustainability.

PS5 Block 4 A (Power Station 5)

Alba's Power Station 5 Block 4 Project: Pioneering Sustainable Industrial Growth in Bahrain

In recent years, the Kingdom of Bahrain has embarked on an ambitious journey towards sustainability and environmental stewardship. This commitment is epitomised by the National Action Plan to achieve Carbon Neutrality, a vision championed by His Majesty King Hamad bin Isa Al Khalifa. Furthermore, His Royal Highness Prince Salman bin Hamad Al Khalifa, the Crown Prince and Prime Minister, has announced Bahrain's Net Zero Carbon Targets, underscoring the nation's dedication to mitigating climate change. Further emphasising this transformative journey, His Highness Shaikh Nasser bin Hamad Al Khalifa, Representative of His Majesty the King for Humanitarian Works and Youth Affairs, has highlighted the collective responsibility for energy security, driven by innovation within Bahrain's domestic energy sector, as stipulated in the Kingdom's National Energy Strategy.

Aligning seamlessly with these national objectives, Aluminium Bahrain B.S.C. (Alba), one of the world's largest aluminium smelters, has demonstrated unwavering commitment to environmental sustainability.

ALBA Oasis - Vegetable Garden

Alba's Commitment to Environmental Stewardship:

Alba's environmental philosophy is deeply rooted in its corporate ethos. The company recognizes that industrial growth and environmental conservation are not mutually exclusive but can coexist through innovative practices and strategic initiatives. Alba's Environmental, Social, and Governance (ESG) Roadmap, launched in April 2022, outlines six strategic priorities:

• Decarbonisation: Implementing measures to reduce greenhouse gas emissions across operations.

• Green Energy & Aluminium: Transitioning to renewable energy sources and promoting sustainable aluminium production.

• Circular Economy & Secondary Aluminium: Embracing recycling and waste reduction to foster a circular economy.

• Employee Welfare: Ensuring the well-being and development of its workforce.

• Collaboration & Partnerships: Engaging with stakeholders to amplify sustainability efforts.

• Transparency, Communications & Due Diligence: Upholding accountability and open communication in all endeavours.

Decarbonisation Efforts: Tree Planting and Solar Initiatives

In alignment with its decarbonisation goals, Alba has undertaken notable initiatives:

ALBA Bahrain Oasis and Lake Project

• Tree Planting: Since late 2021, Alba has been contributing to the nation's goal of doubling its tree cover by 2035. The company has committed to planting 6,000 trees annually, both within its premises and in surrounding communities. This afforestation effort not only enhances biodiversity but also acts as a natural carbon sink, aiding in carbon capture.

• Solar Energy Projects: Alba is launching a solar farm comprising approximately 11,300 photovoltaic panels with a capacity exceeding 6 megawatts. This initiative is expected to reduce carbon emissions by nearly 190 million kilograms over a 25-year span. Additionally, Alba has introduced solar-powered industrial personnel carriers and installed solar charging stations, leading to significant energy savings and a reduced carbon footprint.

Power Station 5 Block 4: A Milestone in Sustainable Power Generation

At the heart of Alba's decarbonization initiative lies the Power Station 5 (PS5) Block 4 project. Officially entering commercial operations on 22 December 2024, Block 4 represents a significant advancement in sustainable and efficient power generation within the aluminium industry.

Project Overview

The PS5 Block 4 is a 680.9-megawatt (MW) combined-cycle power plant, expanding the existing PS5 facility. This addition increases PS5's total capacity from 1,800 MW to 2,481 MW, enhancing Alba's energy self-sufficiency and operational reliability. The project is powered by Mitsubishi Power's state-of-the-art, hydrogen-ready M701JAC gas turbine, known for its superior

Migratory Birds

efficiency and lower greenhouse gas emissions compared to older technologies.

The successful execution of the PS5 Block 4 project is the result of collaborative efforts among several key partners. Mitsubishi Power supplied the advanced M701JAC gas turbine and played a pivotal role in the design and engineering aspects of the project. SEPCOIII, as the Engineering, Procurement, and Construction (EPC) contractor, managed the construction and commissioning phases, ensuring adherence to quality and schedule. ESB International provided Engineering, Construction, and Management (ECM) consultancy during the implementation phase, overseeing technical and operational execution.

Environmental Impact

The commissioning of Block 4 is a pivotal step towards reducing Alba's greenhouse gas emissions intensity ratio by 0.5 tonnes of CO□ per tonne of aluminium produced. This reduction aligns with Bahrain's National Energy Efficiency Action Plan (NEEAP) and the National Renewable Energy Action Plan (NREAP), reinforcing Alba's role as an environmentally responsible smelter.

Project Milestones

The journey of the PS5 Block 4 project is marked by several key milestones:

• Financial Close: In November 2022, Alba successfully reached the financial close for Block 4, securing a $225 million facility supported by the China Export and Credit Insurance Corporation (Sinosure). This agreement underscored international confidence in Alba's strategic direction and commitment to sustainability.

• First Concrete Pour: In September 2022, Alba's Chairman initiated the first concrete pour for the

Solar Vehicles

project, marking the commencement of construction activities.

• Procurement and Foundation Works: By March 2023, Alba completed procurement, and foundation works for the main equipment, keeping the project on schedule.

• Gas Turbine Arrival: A significant milestone was achieved in October 2023 with the arrival of the Mitsubishi Power M701JAC gas turbine, a critical component of Block 4.

• First Fire: In April 2024, Alba achieved the first fire of the gas turbine, initiating commissioning activities and bringing the project closer to completion.

Technological Advancements

The M701JAC gas turbine is a cornerstone of Block 4's advanced technology. Its hydrogen-ready capability positions Alba to adapt to future energy transitions, including the potential use of hydrogen as a cleaner fuel source. The combined-cycle configuration of the plant ensures higher efficiency, as waste heat from the gas turbine is utilized to produce additional electricity via a steam turbine, maximizing energy output while minimizing fuel consumption.

Future Outlook

The completion and operation of PS5 Block 4 signify Alba's proactive approach to sustainable industrial practices. By integrating cutting-edge technology with environmental considerations, Alba sets a benchmark for the aluminium industry, both regionally and globally. The project's success reflects Alba's alignment with Bahrain's national sustainability goals and its commitment to contributing positively to national decarbonisation goals and global climate action.

Dr. S. M. Zakir Hossain
Associate Professor
Department of Chemical Engineering,
University of Bahrain

Floating Photovoltaic Systems: A Game-Changer for Aqua Hydrogen Production in Bahrain

Introduction:

The oil-rich Kingdom of Bahrain is presently advancing towards energy transition, especially in the field of renewable energy. The island nation is investigating cutting-edge technology to diversify its energy portfolio in light of the growing worldwide emphasis on sustainability and clean energy. Integrating floating photovoltaic (FPV) devices for seawater electrolysis-based hydrogen production is an innovative project. Fuel cell technology can also convert the produced Hydrogen into electricity for domestic usage (see Figure 1). This innovative strategy has the potential to transform Bahrain's energy sector and support international efforts to achieve carbon neutrality. Hydrogen is quickly becoming known as a sustainable energy source that can decarbonize the power-generating, transportation, and industrial sectors. However, traditional techniques for producing hydrogen, including steam methane reforming (SMR), are very carbon-intensive. Green hydrogen provides a sustainable substitute since it is generated from renewable energy sources like wind and solar. With its wealth of solar resources, Bahrain is in a good position to use FPV technology to take advantage of this opportunity. An inventive solution to Bahrain's major land shortage problem is the installation of floating solar panels on bodies of water. FPV systems have several benefits over conventional land-based solar farms, such as:

- **Efficient Land Use:** There isn't much land available in Bahrain for massive solar farms. Employing water surfaces, such as reservoirs, canals, or offshore regions, permits the growth of renewable energy without infringing on priceless land.
- **Enhanced Energy Efficiency:** The cooling impact of water improves the efficiency of FPV systems and lowers heat-induced energy losses.
- **Less Water Evaporation:** Installing floating solar panels on reservoirs or desalination facilities can help reduce evaporation-related water loss, which is crucial for arid areas like Bahrain.
- **Lower Maintenance Costs:** Compared to ground-mounted systems, the cooling impact of water can also increase the lifespan of solar panels and lower maintenance costs.

Water Electrolysis for Green Hydrogen:

Water electrolysis is a process that separates water molecules into hydrogen and oxygen using electricity. Figure 2 shows a typical water electrolysis cell. The cathode is the electrode connected to the negative pole of the source of the direct current. This is the point at which the reduction reaction produces hydrogen. A current source's anode is the electrode connected to its positive pole. It is where oxidation reactions and oxygen production take place. Since this process requires electric power, the system is unviable. To make this system economically viable, scientists are trying to get electricity from renewable sources (e.g., solar, wind, bioenergy). An FPV system could

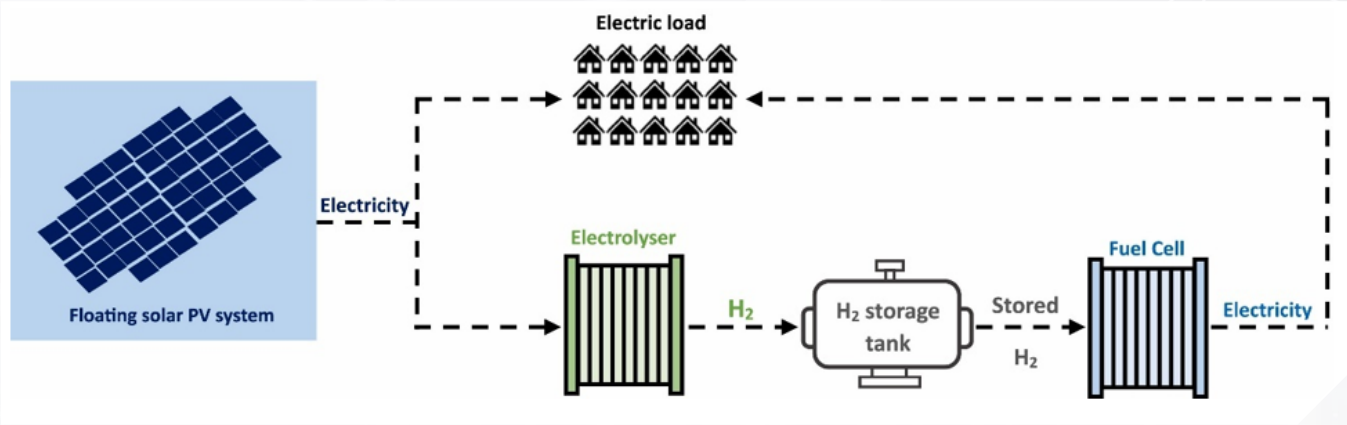


Figure1. Schematic of integration of floating photovoltaics (FPV) technology with hydrogen (H2) energy for electricity production via water electrolyser[1].

be a viable alternative to supply electricity for the water electrolysis, and the generated hydrogen can be utilized as follows:

• Industrial Use: Green hydrogen can be integrated into steel, chemical, and refinery operations to lower carbon emissions.

• Transportation: Fuel cell electric buses, trucks, and other hydrogen-powered automobiles can offer a sustainable substitute for traditional fossil fuels.

• Energy Storage: Intermittent renewable energy sources can be integrated into the grid, thanks to hydrogen's role as an energy storage medium.

Bahrain's Potential and Future Prospects:

Bahrain has taken significant measures to adopt renewable energy, such as establishing clean energy goals and introducing the National Renewable Energy Action Plan (NREAP). Aiming to diversify the economy and lessen reliance on fossil fuels, Bahrain's Vision 2030 is in line with the deployment of FPV systems for hydrogen production. Although FPV-based hydrogen generation offers a promising prospect, several obstacles need to be overcome:

• High Initial Investment: A significant amount of capital is needed to implement FPV systems and electrolysis infrastructure.

• Technical and Regulatory Framework: For widespread deployment, standards, grid integration plans, and regulatory frameworks must be established.

• Water Resource Management: One important factor is ensuring enough water for electrolysis without affecting Bahrain's freshwater supply.

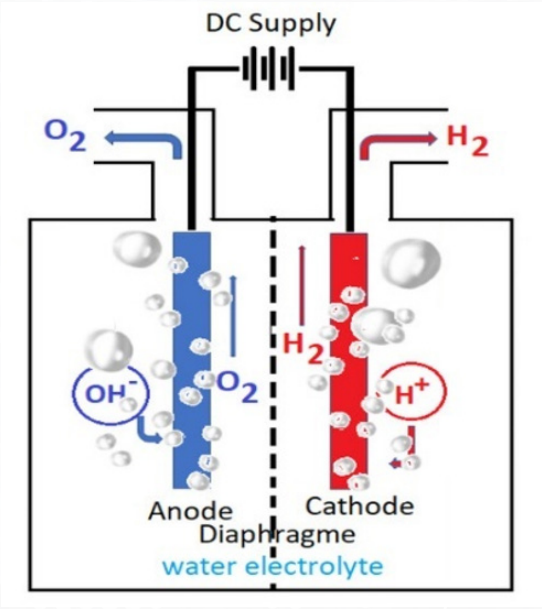


Figure 2. General scheme for a water electrolysis cell. It consists of a direct current (DC) source, an electrolyte, two electrodes (a cathode and an anode), and a diaphragm membrane [2].

Conclusion:

In Bahrain, using FPV electricity to produce hydrogen through seawater electrolysis is a trailblazing move toward sustainable energy. The floating offshore solar and hydrogen industry is a relatively novel and emerging area that associates two renewable energy technologies: floating solar power and hydrogen production. Bahrain may establish itself as a pioneer in the green hydrogen revolution by harnessing its solar potential and adopting cutting-edge technologies. Electrolysis combined with FPV technology has the potential to greatly lower carbon emissions, improve energy security, and promote economic diversification in the Kingdom. Such an approach could be a template for other countries dealing with comparable issues as the globe moves toward sustainable energy.

Engineer Hani Al Khayyat
BANAGAS

Turnaround and Inspection (T&I) Shutdowns in Oil and Gas Plants… Challenges and Solutions

Turnaround and inspection (T&I) shutdown process is an important and crucial process for all process plants in the industrial field, especially oil and gas. T&I shutdown is a planned task which is carried out every specific frequency (for example every 5 years or every 6 years or more or less) to perform certain tasks and activities such as inspection, maintenance, repair and modifications required. Such a process is performed to secure and ensure safety, reliability, efficiency, and operational integrity of the plant for the next frequency and avoid any major or catastrophic failures or consequences in future or while the plant is running. (Small point that I would like to highlight, once I point the word "PLANT" in my article, I mean all components in the plant such as machineries, equipment, piping, tanks, heat exchangers, process columns, vessels, foundations, structures, electrical parts, instrumentations, etc. Also, all other work that cannot be done while the plant is running is considered part of the shutdown activities).

On the other hand, shutdowns are always (by nature), extremely costly and painful to the plant's owners. The entire process of shutdown includes tools, machinery, materials, spares, workforce and on top of this and that is the production loss, as plant will be out of service and production will be discontinued for the entire period of the shutdown. As a result, this will have an impact on the financial returns at the end of the year.

Challenges and Solutions in T&I Shutdowns

Challenges in T&I shutdowns in oil and gas plants are really complicated, serious and hectic. It needs smart planning, intense coordination, close follow-up, knowledge, full understanding (expertism) and execution capabilities.

T&I shutdowns process are critical and complicated. Challenges to be understood carefully and accordingly appropriate solutions to be implemented at the correct stage or phase of the T&I shutdown. Some of these solutions need financing, others need professionalism / expertism, more coordination, proper communication, close follow-up, teamwork, so on and so forth.

Challenges and solutions for execution of successful T&I shutdowns can be addressed in the below points.

Key Challenges and Solutions

1. Planning, Scheduling and Preparation.

Challenges

One of the most complicated issues in planning and scheduling is linking tasks together as shutdown will include different engineering disciplines and more. Turnaround & Inspection shutdowns by nature are huge and complicated scopes and requires multi backgrounds and disciplines within the same shutdown team. Disciplines in principle will include but not limited to, mechanical, electrical, instrumentation, civil, so on and so forth.

On the other hand, shutdown duration is short and limited to avoid production losses as this is another factor to be taken into consideration to cap financial consequences to the organization.

Setting out the timelines of each task and consequently the entire duration of the shutdown is a real pressure to the assigned team. Allocating proper window to each task is important to avoid undesired losses.

Another challenge in this stage is the only available information is the records, registers and the foreseeable (definite and known) tasks only. Furthermore, this topic sometimes makes confusion to the planners as from their experience and knowledge, that certain issues might arise during shutdown as part of the findings but at the same time it is not recorded on papers and forms (physically not in hand). In some situations, insufficient or missing data and records are available only.

Moreover, as long as we are talking about tasks, scheduling, planning, timelines, and so on and so forth, planners shall not underestimate the timeline of tasks for the seek of reducing the entire shutdown duration. A proper and reasonable period to be assigned to every task considering the complexity of each one of them considering safety issues and measures as in oil and gas plants, as all are targeting for "zero risk".

Nevertheless, underestimating shutdown duration while planning and scheduling will lead to a major negative consequence during shutdown, might be compromising quality of work, not meeting certain standards and requirements, safety measures, so on and so forth to catch up with the timeline set. Even more, clients might not receive a positive response from contractors due to the pressure and risk put on them noting that contractors are main stakeholders in such operation.

Solutions

•Assigning professional Planning Engineer(s) and assistants, understanding and capable of linking all tasks and activities together. Having experience in T&I shutdown activities (in my opinion 5 – 10 years continuous shutdowns) and background in other engineering disciplines.

•Determine the role, duty and responsibility of each member of the shutdown team.

•Determine the overall shutdown plan based on a clear and defined scope of work.

•Implementing specialized software to ease the planning process and scheduling of the shutdown tasks and activities.

•Proper judgement on setting the timelines of each task and activity (avoid underestimating) in consultation with other parties concerned of the shutdown team or departments.

•Identify critical path tasks and activities and allocate sufficient timeframe. By determining the critical path, the shutdown period is almost finalized.

• Every engineering discipline shall review previous records and registers to build up their judgements.

• Anticipate (put in mind) any unforeseen issue basis of experience, history, records or any other inputs to prepare ourselves in other aspects and be ready in case such issue takes place.

Outcome: Prioritizing tasks and activities, determining critical path and reducing delays.

2. Scope of Shutdown.

Challenges

In simple words, as much as scope of the shutdown is undetermined, undefined and vague with gray areas, the more complicated shutdown sequence will take place and ending with negative and undesired results such as overrun schedule and or bar chart, receiving

costly bids and offers from contractors, delays in completion, incapability of completion in certain cases due to unavailability of certain specialists and expertise, redoing works, etc.

Improper scope from the initial stage might lead to generating completely a new scope during the actual shutdown work as the initial one is not fitting the actual shutdown requirement. This will result in huge variations due to uncertainty and production losses due to delays.

Uncovered scope(s) will drag the shutdown to the same consequences mentioned earlier as this part of the scope was not covered originally which might result in the last moment in no materials or spares available, lack of additional manpower or machinery coverage due to not covered from the beginning, so on and so forth.

Three main factors forming the triangle of project failure. Apart from this triangle is the scope. The project failure triangle comprises of (1) scope, (2) cost and (3) time (all 3 factors priority wise) which shows the importance of how the scope to be defined, shaped, determined and clear. Once scope is defined properly, then the estimated cost of the shutdown or any project will be met and completed within the timeframe set. The relation between the three of them is as follows; the more undetermined and vague scope the more overrun cost and overrun time, OR in other words the better or more determined and clear scope the more cost and time is met.

Undetermined scope does not put the contractor only in risk, but the entire team, organization and contractor will be put in risk which will destabilize the entire shutdown and forcing the organization to have certain immediate corrective actions formed in repeating or redoing the works, variations, calling help from external bodies. All this process will be reflected in the overrun of cost and time and consequently failure of shutdown.

Solutions

• Determine clear, defined and detailed scope of work.

• Determine the required standards, codes, procedures, etc. to be implemented as part of quality assurance and control.

• Assigning professional Engineers and assistants in different disciplines that can draft a proper scope of work. Having experience in T&I shutdown activities (in my opinion 5 – 10 years continuous shutdowns) and background in other engineering disciplines.

• Use previous T&I shutdown data, readings and records to set up the scope along with the manufacturer's manuals. Analyze such information that might lead to a certain anticipation which may help drafting the scope of work.

• Listing down anticipated scope of work containing tasks and activities having a probability of occurrence or not and being prepared if happened.

• Having smooth change management for any part of the anticipated scope of work in all aspects such as financially, technically, availability of resources, etc.

Outcome: Clear and defined scope will ease the execution of the T&I shutdown in all stages. Moreover, the success of the shutdown is assured as it will result in completion of shutdown within the estimated cost and timeframe.

3. Experience, knowledge, skills, and practice.

Challenges

These are the key personnel (workforces) such as engineers, experts, specialists, technicians, etc. who are playing a leading role in shaping the plan, schedule, scope of work, execution, decision making, so on and so forth. In the paragraphs below, I'm not tackling specific stage only such as the execution stage or planning stage or preparations, or forming the scope but, I'm tackling the entire T&I shutdown operation from "A" – "Z", as these skills, experience, knowledge, etc. are needed in every stage of the T&I shutdown as each stage is integrating the next stage.

All workforces shall be coming from different engineering backgrounds and others as needed to perform a complicated job starting from the planning stage passing to preparations till handover, recommissioning, and startup.

This complicated job needs problem-solving features and instant decision-making to proceed ahead, especially during the implementation of the shutdown. On the other hand, practicing shutdowns is a particularly

principal factor, as the more participating and practicing shutdowns, the more gained experience and knowledge.

Depending on young personnel and newcomers will collapse the shutdown as this role does not depend on smart or intelligent personnel only but it depends on experience, knowledge, practice, and skills, which are preferred to be integrated by smartness and intelligence.

Being confident in taking decisions (right and instant decision) is a vital issue especially during shutdown to ensure that decision is taken correctly and in the right time (without wasting time) as each minute wasted is counted back and having value if translated to production.

Assigning expert, skilled, and knowledgeable personnel as part of the shutdown team is a "MUST ISSUE" to ensure success of the shutdown. Furthermore, at the same time another "MUST ISSUE" is to prepare a new generation strengthened with T&I shutdown knowledge, practice, skills, and experience to take over the mission easily when needed. In another simple words, the reliable and trustworthy generation shall transfer all gathered knowledge, skills, and experience to the next generation to enable them to continue the mission practically and safely.

Solutions

• Forming T&I shutdown team. Teams shall include different disciplines with shutdown background and knowledge. A representative and his reliever shall be part of the team representing every discipline or department for better follow-up, handover and communication.

• Assigning competent key personnel (workforces) such as engineers, experts, specialists, technicians, etc. with extensive knowledge, skills, practice and experience.

• Preparing a second generation of engineers to take over in future by the trustworthy generation.

• Making sure that apart from the assigned team shall have a problem-solving feature and capable of taking immediate decisions.

• Setting certain criteria such as number of years of experience in T&I shutdowns, qualifications, number of shutdowns involved, etc. as part of the tender document for the outsource personnel.

• Reviewing the CV's, qualifications and credentials of the key personnel such as engineers, specialists, etc. for the outsourced personnel.

• Assessing certain skills such as communication, problem-solving, teamwork, collaboration, their understanding of the standards, codes and procedures.

• Specifying that certain professions shall have 3rd party certificate to ensure their competency.

Outcome: Having an appropriate and competent team that is able to drive the shutdown in all stages will lead to getting the shutdown completed as planned and meeting the estimated cost and timeframe.

4. Technology Challenges.

Challenges

Implementing equipment, machinery, tools, software, inspection devices, etc. with new and latest technology is essential to ensure ease of shutdown process and time effective as these techniques will integrate human efforts in all disciplines and stages.

Using old and outdated equipment, machinery, tools, and software can lead to a major challenge and disruption in the process of the shutdown. Frequent breakdown from now and then during the shutdown due to incompetency will increase the duration of the shutdown unnecessarily and consequently the cost (as time is translated to cost).

Furthermore, depending on singular technology or technique for a lengthy period might have limitations eventually (considered outdated) on performance and outcomes. Likewise, old software will have limited capabilities for scheduling and programming purposes with limited features and flexibility.

Software is mostly related to planning stages for programming. Moreover, equipment, machinery and tools are used during the practical work of the shutdown.

Solutions

• Using the latest software for planning and scheduling during planning and scheduling stage which has advanced features, controlling tools and powerful outcomes.

• Using the latest technology in equipment, machinery and tools during actual shutdown works as long as it will help and reduce duration and risk.

• Using the latest technology in inspection devices and equipment during actual shutdowns works to have accurate readings and save time.

• Implement modernization strategy as part of the shutdown activities to upgrade the Plant dynamic components (such as mechanical, instruments, electrical, etc.).

Outcome: Implementing the latest technology will help in obtaining more accurate results, minimizing human errors, speeding up inspections and enhancing safety perspectives.

5. Management and Allocation of Resources.

Challenges

Proper allocation of resources in its correct place including personnel is an important task in the success of the T&I shutdown operation. Correct qualification and required number or quantity is a basic issue to work out the required resources rather than assigning multi tasks or responsibilities to the same resource.

Improper management and allocation of resources will result in extension of time (delay) and consequently cost. Improper influx of all resources whether workforce, equipment, machinery, etc. in the right timing will cause congestion, more downtime and delays.

Materials, spares, etc. if not arrived in a timely manner and delivered to site will cause disruption to the progress, sequence, and flow of work.

Solutions

• Inviting and hiring reputed and experienced contractors that are not necessarily mechanical contractors, but mechanical contractors specialized in T&I shutdowns.

• Form shutdown team from each discipline and avoid understaffing or overstaffing. Preference to have (in my opinion) front line and backup line of the manpower allocation.

• Assign shutdown team leader to manage the team and the entire shutdown.

• Call all specialists that are required from OEM's (Original Equipment Manufacturer) to take part in the shutdown activities that are related to that equipment or machine.

• Ensure proper allocation and influx of all resources (mainly manpower, equipment and machinery) to be in line with shutdown schedule or bar chart to avoid congestion and downtime and delays.

• Place orders and procure spares, materials, consumables, etc. well in advance to ensure early arrival prior to shutdown due date. Care to be taken for items that are related to critical path tasks and activities.

• Top up stock items basis of need, historical data and records.

Outcome: Ensure professional execution, on time, right resources avoiding under resourcing or over resourcing and preventing delays.

6. Health, Safety and Environment.

Challenges

Entire shutdown activities in places such as the oil and gas industry is causing a major hazard. Every task or activity is to be assessed and precautions to be taken to minimize and mitigate risk. Such plants are full of hydrocarbons, high pressure equipment, confined spaces, elevated working places, toxic materials, flammables, so on and so forth are ranked as highly risk places.

Most of the activities and tasks are carried out concurrently and parallel to each other to catch up with the timeframe of the shutdown. With such dangerous work, available workforce and assets are exposed to potential hazard and major incidents such as fire, gas leak, injuries, etc.

Toxic waste, chemicals, highly flammable materials, emissions, steel, etc. are generated as part of the industrial waste from the shutdowns. These are to be handled properly complying with local regulations and rules as these wastes have a negative impact on the environment.

Proper PPE's and others to be used to protect health and safety of the available personnel from activities of the shutdown.

Most safety challenges are taking place during work due to shortcuts, negligence, improper risk assessments, insufficient safety coverage, human errors, unrecording of near misses, etc.

Solutions

• Considering (always) safety is the topmost priority and conducting a thorough risk assessment that is related to safety.

• Conducting thorough assessment that is related to environmental impact.

• Conducting safety inductions and courses.

• Implementing safety protocols and procedures.

• Implementing contingency plans.

• Following all rules and regulations that are related to the environment.

• Ensuring full safety coverage such as job watchers, safety officers, gas detectors, gas testers, etc.

• Ensuring full safety stand-by or frequent safety check or roaming on site, based on how dangerous, hazardous the work is and procedures.

• Ensuring the area is free of gases and hydrocarbons or within the permitted limits.

• Disposing of toxic or chemical waste in line with local authorities' regulations and manufacturer's instructions.

• Correct PPE's to be used basis of the nature of the activity carried out.

• No violation to be accepted and immediate correction action to be done.

• Implementing "PERMIT" system. Permit protocol to be prepared by a certified supervisory level person at least (not labor).

• Safey officers and job watchers shall be certified, knowledgeable, skilled and preferred to be within oil and gas plants industry background. Interviewing will help in measuring these trades and the extent of experience they have, knowledge and practice.

• First aiders and ambulances to be available and ready round the clock as long as the shutdown is progressing.

Outcome: Reducing downtime caused by any incident. Ensuring compliance with safety laws, standards and maintaining safety record.

7. Coordination and Communication.

Challenges

A pivotal tool to address and deliver concerned notes, messages, information, updates, ideas, etc. to stakeholders involved directly and indirectly.

Miscoordination and miscommunication can deliver short information and make confusion and misunderstanding to other stakeholders in the shutdown. This confusion and misunderstanding may result in redoing the work, delays, more safety risks, etc.

Solutions

• Assign representatives from each discipline or department to unify the communication channel. This is the control room or the headquarters that is managing and directing the T&I shutdown progress.

• The workplace of the shutdown team shall be fully equipped, such as land line telephone, intrinsically cell phones, wireless devices, fax, photocopy machine, etc. to ease their operations.

• Allocating specific timing for meetings and discussing the progress, milestones of the shutdown and any complex issue popping out to resolve proactively. Preference to be daily meeting at least twice a day (within 24 hours).

• Introduce communication equipment and devices to ease instant communication between all personnel.

• Set up a centralized communication platform (to be part of the shutdown team) to receive work progress updates and status (documented) to have proper updates and follow up. Furthermore, any further required investigation and tracking.

• Thorough handover (face to face discussion and written as part of the logbook) to be given to the next shift (during the shift turnover).

Outcome: Keeps all the team aware of the work progress (what are the tasks in progress, what are the tasks

completed and what are the tasks to be started) and consequently, reducing miscommunication and proper coordination.

8. Aging of Plant and Facilities.

Challenges

As much as the age of the plant grows older, the more complicated cases and scenarios will arise especially during shutdown period. Dealing with aged plants is one of the most complicated issues as unpredictable findings and observations will be detected and unfortunately in worser cases might be detected towards the end of the shutdown.

Increased probability of discovering additional damage or findings (unforeseen or unpredicted) once equipment are opened for inspection and insulation is removed. Detecting such findings can complicate repairs, modifications, upgrades, and cause disruption to the shutdown schedule and drag the completion date and startup.

The more aged plants are the costliest in shutdowns, requires more attention, knowledgeable and experienced workforce.

Solutions

• Predicting and anticipating the worst scenarios to prepare ourselves in case it happens. Preparing ourselves is not only psychological but includes resources, especially materials and spares.

• Preparing multi plans (plan "1", plan "2", plan "X") and implement in upon occurrence of any surprise's basis of findings.

• Drafting a precise scope, taking into consideration previous data and records

• Being flexible and adaptable as much as the situation requires to overcome any complexity and downtimes and consequently delays.

• Assign the most knowledgeable and experienced workforce during the planning, preparation and actual work of the shutdown.

• Carrying out pre-shutdown activities and detecting potential issues and readings. Include in scope of shutdown and take necessary action.

• Utilize the analytical reports and data of Risk Based Inspection (RBI's) studies to predict future requirements and type of repairs.

• Storing multi spares of the same part to continue business prior to becoming obsolete (out of production).

• Modernizing the plant components such as dynamic equipment, instruments, etc. to avoid obsoletism.

• Introducing the latest technology, equipment and machines from the beginning that comply with new regulations related to the environment, for example.

• Reviewing continuously the inspection and maintenance done against the actual efficiency of the component and manufacturer's catalogue. Conduct life assessment study to determine the lifecycle of that component.

Outcome: Reduces workload and avoids or minimizes surprises during shutdown. Enhances the shutdown efficiency and reduces costs.

9. Not Utilizing Previous Lessons from Shutdowns.

Challenges

Lessons learned pivot is not less important compared to other challenges. Ignoring or neglecting mistakes, misunderstandings, miscommunications, so on and so forth is a key factor to learn and increase knowledge of understanding, improving experience and self-development.

If no proper management of lessons learned by recording all mistakes, shortages, etc. including conducting sessions for such points will result in repeating the same issues in future shutdowns.

To me (in my opinion), mistakes (though it is not desired) but at the same time it is an opportunity to learn, and considered on the job training, as we are learning once that mistake takes place to not repeat so and so mistake that we made earlier.

No consideration of learning previous mistakes will lead to repeating the same mistakes more and more without future improvement, without building-up knowledge and experience. Negative impacts will pop up more and more such delays, financial consequences, unnecessarily

complexity, losses of production, etc.

We can turn that mistake into a positive opportunity to build-up confidence by improving our knowledge, skills, and experience through learning our previous mistakes "(Lessons Learned)" to enable ourselves to overcome any problem or mistake that might happen to achieve target.

A mistake that happened means "past", in other words, it means that it became a "fact" which we cannot change or ignore (whether we like it or not) and needs immediate action to overcome any undesired consequences whether technical or financial. Though the fact is undesired and causes additional stress, the beauty here is that we utilize this opportunity and learn from it. As much as the work is routine, no complexity and mistakes, our gaining (developing) of experience and knowledge will be limited. Real learning will come from complex cases and mistakes that will build-up skills, experience, knowledge, and confidence.

Solutions

• Documenting all findings, observations, mistakes, misunderstandings, miscommunications, etc.

• Conducting post-T&I shutdown lessons based on the findings, observations and mistakes that happened during the shutdown.

• Conducting pre-T&I shutdown lessons based on the findings, observations and mistakes that happened during the past shutdowns (for the purpose of regenerating information in minds).

• All lessons shall be supported by photos, videos, etc. for ease and better understanding.

• Acknowledging mistakes and converting it to a positive opportunity to improve knowledge and skills. (Mistakes are totally undesired but considered as a valuable opportunity to learn and build up knowledge and skills. Considering that I learnt not to do so and so again as that process will increase trust and confidence in ourselves. Moreover, mistakes are more or less, to a certain extent UNAVOIDABLE).

Outcome: Lessons learned will enhance future T&I shutdowns efficiency and reduce mistakes.

10. Training and Development.

Challenges

The success of any organization is measured against the competency of the workforce of that organization. As part of the competency, training plays a leading role in enhancing and improving the capabilities, skills and knowledge of the workforce. Therefore, training issues are to be considered as part of the "MUST" list and priorities, moreover, it is a necessity and not luxury and image.

Big mistake that all or majority of the shutdown team having limited experience and did not practice shutdown works enough. This will cause disruption and fluctuation of the shutdown operation and have negative consequences, which will be reflected on the performance of the workforce of the team in various aspects such as work progress, knowledge, decision making, planning, execution, so on and so forth.

Training is an investment, and fruits will be harvested after a while, likewise investment in projects, profit will be seen after a while. As part of the investment, the gained knowledge will be reflected in the upcoming opportunities (shutdown). Training to be considered as a necessity and not as a burden due to cost.

Lack of training will lead to limitations in knowledge and skills due to short information and being unaware of the latest issues that will pop out in the market such as related issues to IT software, technology, techniques, etc.

Solutions

• Set a healthy and effective training plan that is related to shutdowns in all perspectives such as planning, etc.

• Carrying out on the job training (OJT) beside the theoretical training.

• Maintaining the frequency of training and considering it ongoing process from time to time.

• Exchanging knowledge, experience and practices between the shutdown team members. Furthermore, exchanging knowledge, experience and practices between similar process organizations.

• Set part of the goals and objectives as part of the Yearly

Performance Evaluation of the trustworthy employees to transfer such knowledge and tips to the newcomer's generation.

• Introducing theoretical and practical training scope as part of any package to replace certain equipment of machine such as compressor, turbine, or even purchasing new devices for inspection or software.

• Allocate a considerable budget to take care of the training plan.

• Assigning T&I shutdown expert (might be from the organization itself) to train, mentor and coach the 2nd line generation on regular basis to prepare them prior to handling the responsibility.

• Taking into consideration the best way of training to rise-up the engineer's capabilities and knowledge in different ways such as OJT, theoretical courses, practical courses, exchanging knowledge, having training in other organizations, etc.

Outcome: Investing in the training and development of the key people will increase knowledge, skills and experience which will reinforce the capabilities and reflect positive on the performance and confidence during T&I shutdowns.

11. Financial Constraint and Issues.

Challenges

T&I shutdowns are serious and have intensive quantum of work to be planned and executed within a limited timeframe and losses of production within the same timeframe of the shutdown.

Due to the high cost of main contractor(s), subcontractors, specialists, expertise, Original Equipment Manufacturer (OEM), materials, equipment, spares, variations, overtime, etc. could overload the budget. Not only that, but multi shutdowns of other different facilities within the same year could extremely overload the budget and form a strain on the organization.

On the other hand, organizations will not sustain the cost of the actual shutdown only but will sustain the reduction in revenue due to production losses within that period.

Solutions

• Allocate considerable funds to cover the entire scope of the T&I shutdown including contingencies to cover unforeseen findings.

• Reviewing and updating budget considering revenue and expenses.

• Splitting orders of spares, materials, etc. instead of considering all needs in one go.

• Prioritizing the needs of the organization and giving priority to the shutdown budget.

• Working hard to make some savings to direct these savings towards the shutdown budget and expenses.

• Purchasing services and materials to be through transparent competition and tendering process to ensure receiving the most competitive bids and consequently making savings.

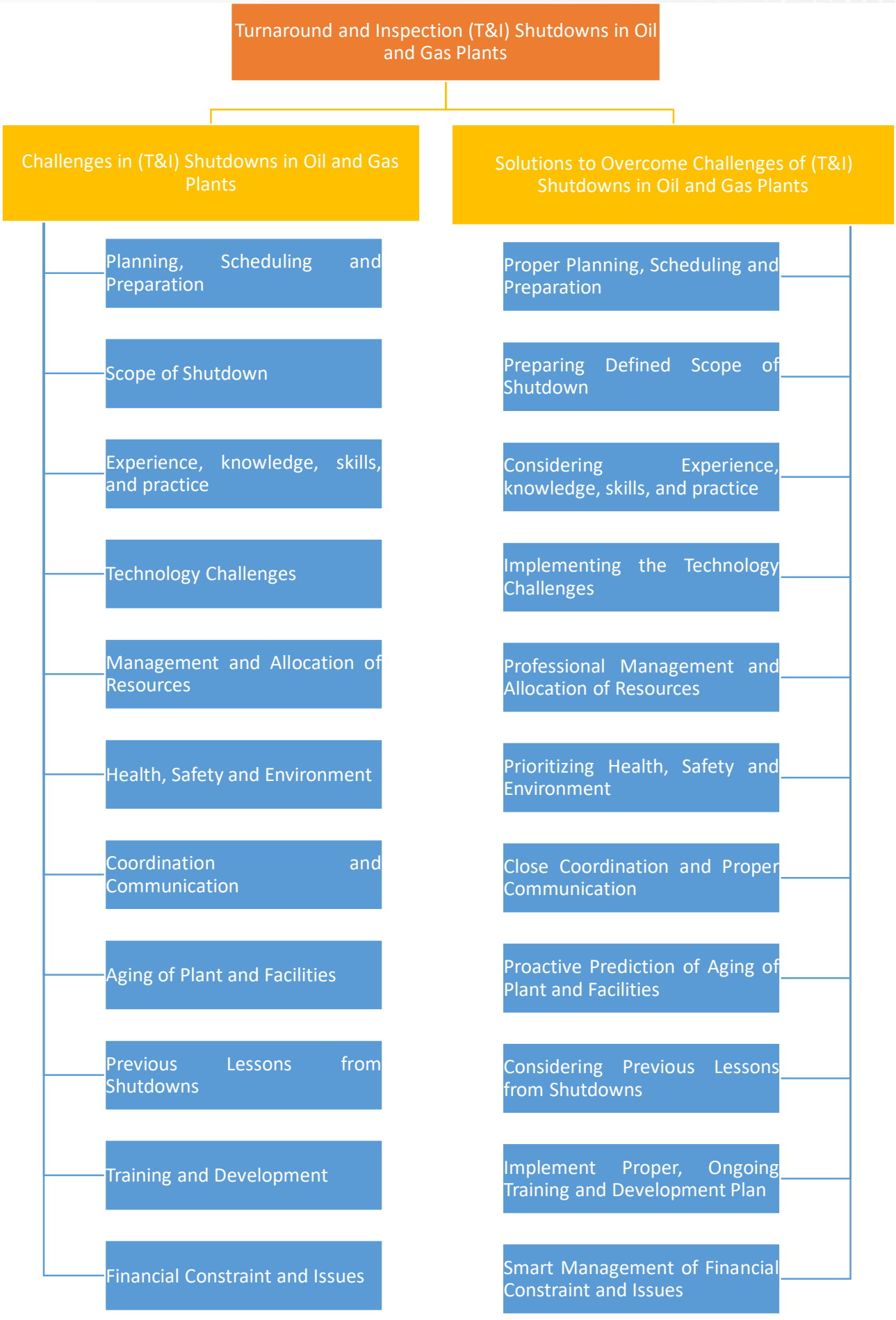
• Deducting suitable amount from the yearly revenue to support to cover the losses of the year of shutdown considering entire expenses of shutdown including loss of production.

Outcome: Reducing costs, expenses and directing funds towards the most prioritized subject (T&I shutdown). Proper management of funds and finally, enabling the organization to execute the shutdown expenses.

Conclusion

Addressing and Understanding challenges in T&I shutdowns professionally is a dynamic and "MUST" issue to be taken into consideration prior to any shutdown to ensure smooth progress and successful shutdown. Overcoming challenges is integration of multi discipline and expertism to transform the plan of shutdown on papers to a fact on ground and success.

Next, understanding and putting into consideration the above solutions will enable any entity to streamline the T&I shutdown tasks and activities, reduce downtime, optimize resources effectively, ensure smooth progress and startup. Integration of the above solutions will enable overcoming shutdown challenges, success and bringing back the plant to its reliability, efficiency and operational competency.


Turnaround and Inspection (T&I) Shutdowns in Oil and Gas Plants
Challenges in (T&I) Shutdowns in Oil and Gas Plants
Solutions to Overcome Challenges of (T&I) Shutdowns in Oil and Gas Plants
Planning, Scheduling and Preparation
Scope of Shutdown
Experience, knowledge, skills, and practice
Technology Challenges
Management and Allocation of Resources
Health, Safety and Environment
Coordination and Communication
Aging of Plant and Facilities
Previous Lessons from Shutdowns
Training and Development
Financial Constraint and Issues
Proper Planning, Scheduling and Preparation
Preparing Defined Scope of Shutdown
Considering Experience, knowledge, skills, and practice
Implementing the Technology Challenges
Professional Management and Allocation of Resources
Prioritizing Health, Safety and Environment
Close Coordination and Proper Communication
Proactive Prediction of Aging of Plant and Facilities
Considering Previous Lessons from Shutdowns
Implement Proper, Ongoing Training and Development Plan
Smart Management of Financial Constraint and Issues

Engineer Mohammed Mubarak during his participation in presenting the Ramadan Ghabga (2024) for the Bahrain Society of Engineers.

Portrait

Engineer Mohamed Mubarak plays a key role in Engineering and Technical Department at Bapco Gas Company, a leading government-owned company in the oil and gas sector. In his position, he contributes to streamlining tendering processes and ensuring high-quality execution of various projects that improve operational facilities and align with the company's strategic goals. Mohamed is known for his dedication, structured mindset, and ability to lead projects that bring tangible improvements to operations..

Academic Qualifications:

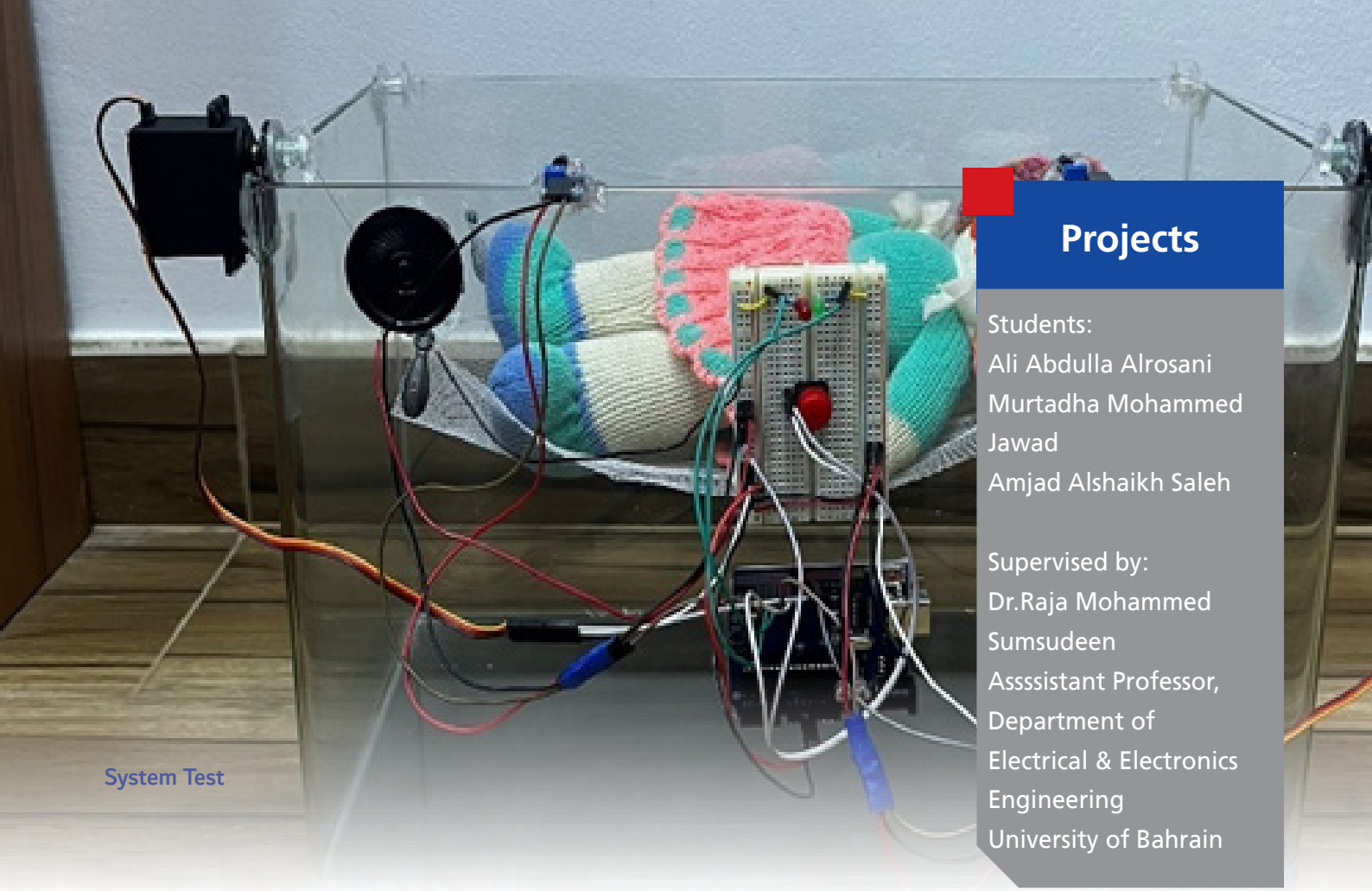
- Bachelor's Degree in Mechanical Engineering – University of Bahrain (2018).

His Major Achievements and Contributions:

• Managing and executing various projects that positively impacted company facilities.
• Managing and executing various major shutdown projects, all completed within planned schedules.
• Developing multiple tenders that enhancing efficiency and workflow across the department.
• Active member in Bahrain Society of Engineers since 2019.
• Actively involved in several committees, including Membership Committee, Conferences Committee, and Activities and Social Committee.
• Participated in organizing multiple conferences and events arranged by Bahrain Society of Engineers..

Engineer Mohammed Mubarak

Engineer - Contracts & Tendering,
Engineering & Technical Department,
Bapco Gas Company



System Test

Projects

Students:
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Design and Development of a Sensor-Based Low-Cost Drowning Detection System for Human Life Safety

Drowning is a significant public health concern, with over 320,000 drowning-related deaths reported annually worldwide. Coastal drowning in the United States alone accounts for US$ 273 million each year in direct and indirect costs. Similarly, in Australia and Canada, the total annual cost of drowning injury is US$ 85.5 million and US$ 173 million, respectively. This project addresses the critical need for enhanced safety measures in swimming pools by developing an intelligent drowning detection system. The system leverages a combination of advanced sensors and real-time monitoring technologies to detect and respond to potential drowning incidents.

A key component of the design is a wristband that incorporates heart rate, oxygen level, and motion sensors, allowing continuous monitoring of individuals in the pool. The system is designed to identify the three types of drowning: normal drowning, dry drowning, and secondary drowning. Additionally, an infrared (IR) sensor is deployed to detect any unauthorized entry or fall into the pool when it is unoccupied.

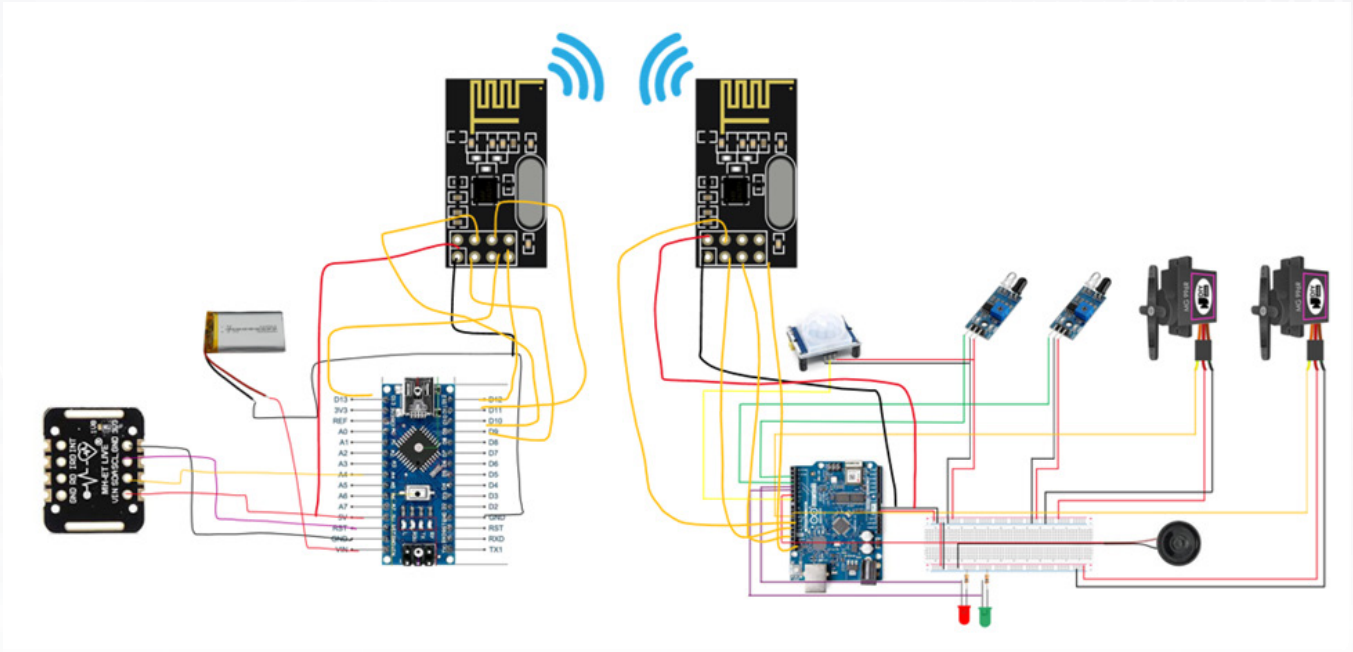

Figure (1) Project System Circuit Diagram

The project aims to investigate and implement the most effective sensor technologies, reduce false alarms through intelligent algorithms, and integrate these technologies in a manner that ensures user safety and privacy. By providing real-time alerts and initiating rescue protocols, the system minimizes the risk of drowning accidents and offers a robust solution for both public and private swimming pools.

This system not only enhances safety but also reduces liability risks for pool operators, provides peace of mind for individuals, and promotes the adoption of life-saving technologies in recreational spaces. Through this project, we aim to make a meaningful contribution to reducing drowning fatalities and improving public health standards by developing a low-cost and accessible solution.

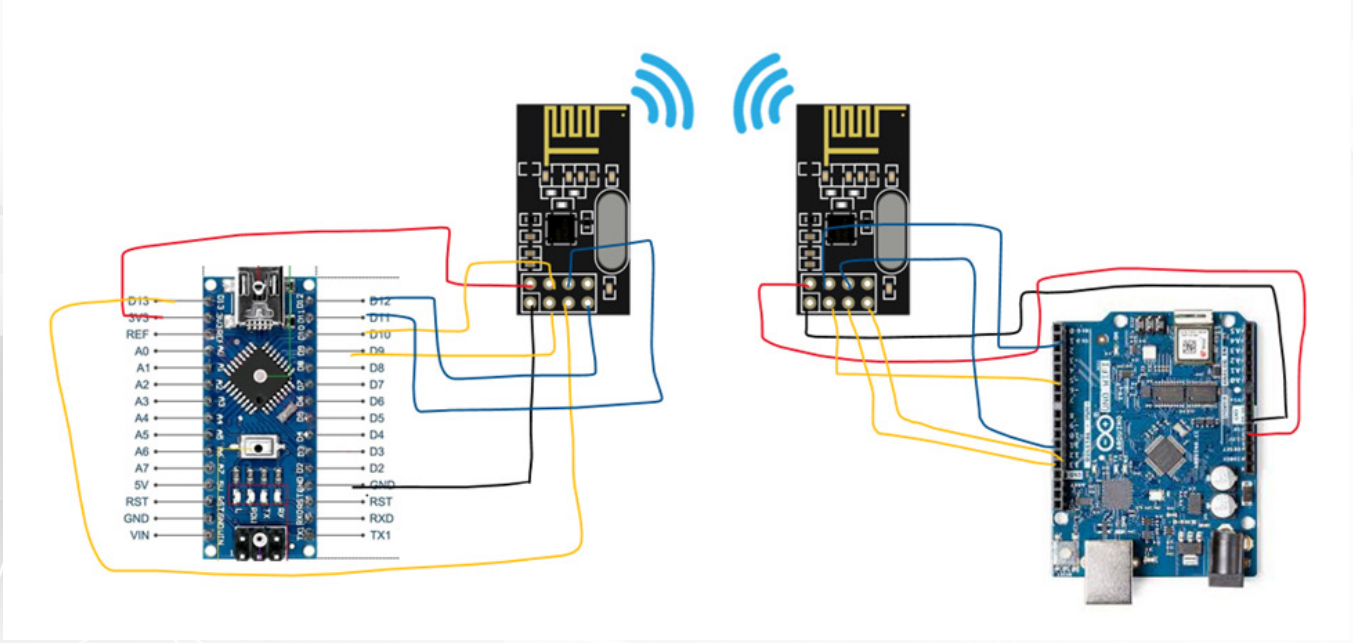

Figure (2) Communication System Circuit Diagram

Projects

Students:
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Smart Water Management System for Home Plants

The Smart Home Water Management System is an innovative solution designed to optimize plant care by automating the irrigation process based on real-time environmental data. Utilizing a network of sensors, including soil moisture and light sensors, the system continuously monitors the water and sunlight

Figure (1) Blynk app

needs of plants. When the sensors detect that a plant requires water or more sunlight, the system automatically activates a water pump to irrigate the plant, ensuring it receives the appropriate amount of water without human intervention. This smart system not only enhances plant health but also promotes water conservation by preventing over-irrigation. Additionally, it reduces the need for manual monitoring, offering an efficient and user-friendly approach to plant care in smart home environments. Through this integration of IoT and automation, the project aims to streamline plant management, improve resource efficiency, and contribute to a sustainable, ecofriendly living space.

Figure (2) Final Assembly of Pump, Valve and Sensors on Water Pipes

Figure (3) The Final Assembly and Design of Smart Water Management System for Home Plants

Projects

Students:
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Design of a Power-Assist Device (PAD) - for Manual Wheelchairs

This project presents the design and development of an electric add-on device that can be readily fitted to a standard manual wheelchair to transform it into an electric-powered tricycle. The gadget is intended to improve mobility and independence for those who have physical disabilities. The designed device is called power-assist and can be described as a handcycle. Electrical, electronic, and mechanical design aspects were considered in the developed device that enable the disables to attach it to the standard wheelchair easily and safely. Combining ergonomic design principles, robust engineering, and user-friendly controls, the handcycle provides a cost-effective and versatile mobility solution. By addressing challenges such as physical fatigue, limited accessibility, and dependence on caregivers, this project aspires to improve the quality of life for individuals with mobility impairments and promote social inclusion.

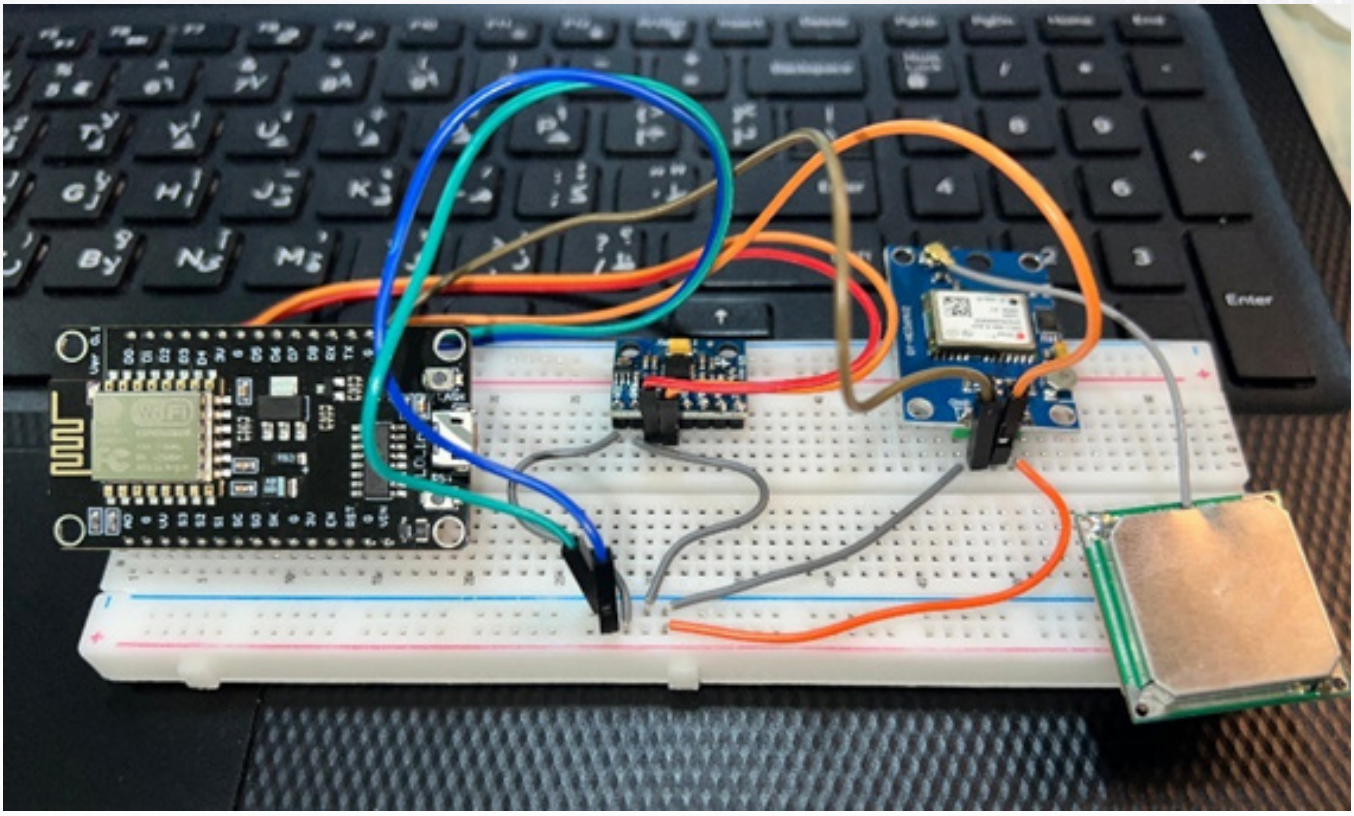

Figure (1) Circuit Connection on Breadboard

Figure (2) Complete Design of Power-Assist Device (PAD)

Figure (3) Photo of Design

Projects

Students:
Abdulla Ali Ahmed
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Smart Inflatable Life Jacket for Child Safety and Swimming Learning

Drowning remains a significant cause of accidental deaths among children in Bahrain, with approximately 7 cases reported annually, down from 16 cases about five years ago. Alarmingly, 95% of children in Bahrain have not learned how to swim, according to a study, and swimming pools are the most common sites for drowning incidents. This highlights the urgent need for innovative solutions to enhance child safety in water and promote swimming education as a critical life skill. Current life jackets in the market hinder swimming education by keeping children afloat continuously, making it impossible to practice swimming techniques effectively. To address this issue, this project introduces a Smart Inflatable Life Jacket designed to combine safety with swimming learning in an efficient and user-friendly manner. The smart life jacket operates both automatically and manually to prevent drowning incidents. It is equipped with sensors and a control system to monitor the child's condition in real time. A heart rate sensor detects elevated heart rates that might indicate panic or distress, while a moisture sensor identifies when the child enters the water. If both conditions are met simultaneously, the system automatically inflates the jacket. The inflation mechanism is triggered through an electronic relay, which activates a solenoid valve to release air from a compressed cylinder, ensuring rapid deployment of the life jacket to keep the child safe. The control and monitoring system utilizes a microcontroller to process sensor data and send real-time notifications to a smartphone application. This application allows guardians to monitor parameters such as water presence, heart rate, and the operational status of the jacket. A manual push-button on the application's dashboard provides an additional layer of control during emergencies. The innovative design of this life jacket addresses

two critical needs: ensuring safety during emergencies and enabling children to learn swimming without constant buoyancy interference. This solution aims to significantly reduce drowning incidents among children in Bahrain while fostering a culture of swimming education and water safety. It represents a step forward in using modern technology to tackle real-world safety challenges effectively and efficiently.

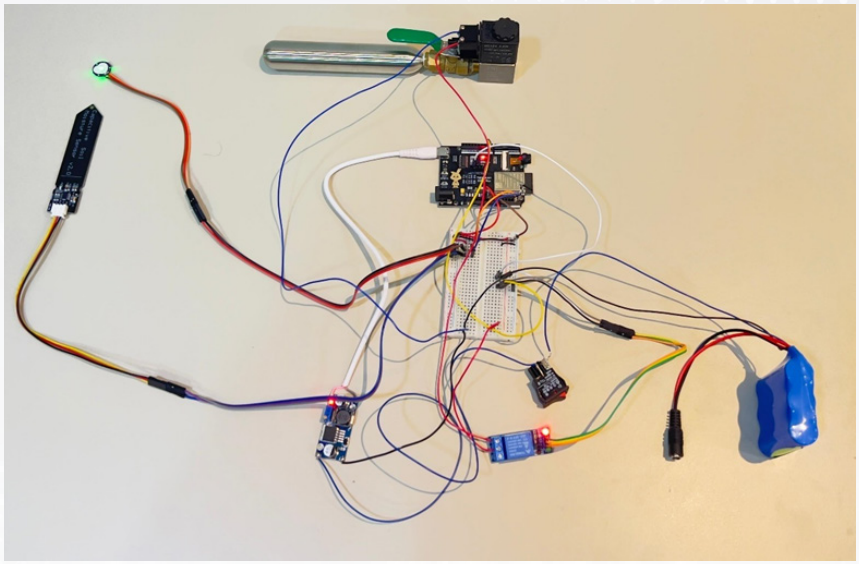

Figure (1) Final Circuit Design

Figure (2) Heart Rate Monitoring Design

Figure (3) Final Circuit Integration