CITIZEN'S ADVISORY COUNCIL TO LA PORTE INDUSTRY

Impact of AI on the Petrochemical Industry

Seth Robins, representing the Houston AI Institute and working as a data scientist in the chemical industry, presented an overview of how artificial intelligence is being used in chemical plants and where its capabilities and limitations lie. He began by explaining that AI is not new to the industry. Automation and control systems have been used for decades, followed by robotics and machine learning. More recently, generative AI and large language models (LLMs) have expanded the capabilities of AI. Machine learning can analyze large amounts of historical data and identify patterns, while newer time-series models can use historical trends to help predict what may happen in the near future. Generative AI builds on these technologies to produce new content and potentially model future scenarios.

In chemical plants, AI generally does not operate directly within the plant's control systems. Data from sensors and distributed control systems (DCS) is collected and transferred to other systems, often in the cloud, where AI models analyze it. If information from a model needs to be returned to the plant, it goes through security and validation checks to ensure the information falls within established operating limits. AI is primarily used as a tool to monitor large amounts of information, identify patterns or unusual conditions, and bring issues to the attention of engineers and operators. It does not independently open or close valves, override safety systems, or make final decisions. Safety systems remain separate from AI and the plant's control systems.

The presentation focused on four major areas where AI can benefit chemical plants: safety, reliability, environmental protection, and energy efficiency. AI can compare current operating conditions with historical data to identify optimal operating conditions and make recommendations. Machine-learning cameras can monitor work areas in real time and identify unsafe activities or conditions, while cameras can also be used to detect potential leaks or loss of containment. AI can analyze large amounts of equipment data, including vibration, corrosion, and thickness measurements, helping engineers identify developing problems before equipment fails. Early identification of equipment problems can allow plants to schedule maintenance or controlled shutdowns and potentially avoid unexpected failures, flaring, and other events that could affect the surrounding community.

Robins explained that much of the information used to train AI models comes from plant historians, which can store years of data on variables such as pressure, temperature, flow, and levels. AI can analyze this information much faster than a person and can help reduce the amount of data engineers and operators must manually review. However, AI cannot simply be applied to a large data set and expected to figure everything out. Experienced engineers and other plant personnel are needed to identify, label, and explain the data so that the model understands what it is analyzing.

A major limitation of AI is that it can be confidently wrong. LLMs, such as ChatGPT, are probabilistic systems that predict likely responses rather than determining a single correct answer. They also cannot know information they have never encountered. Poor-quality or improperly labeled data can likewise result in poor model output. Models must therefore be monitored and maintained, with systems in place to identify bad outputs, missing data, or problems with the data pipeline. If equipment or operating conditions change significantly, the model may also need to be retrained or replaced.

Robins emphasized that AI should currently be viewed primarily as a recommendation and information-generation tool, with people continuing to make the final decisions. He does not believe today's LLMs should be trusted to control a chemical plant. Even if certain machine-learning models eventually take on some control functions, safety systems would remain separate. Human oversight remains essential, particularly because operators and engineers need to evaluate whether an AI recommendation actually makes sense rather than simply accepting it.

The presentation also addressed employment and the future workforce. Robins said the industry will continue to need Process & Reliability Engineers, Data Engineers, Data Scientists & Analysts, and Operators & Technicians. The most valuable people may be those who combine plant knowledge and experience with an understanding of data and AI. Preparing and organizing plant data can take considerably longer than actually building an AI model, making data preparation an important area of need. Operators and technicians will also remain important because they provide the practical knowledge needed to evaluate AI-generated information.

Robins addressed what happens if AI or the infrastructure supporting it becomes unavailable. Plants are designed so that their essential control systems can continue operating without an outside connection. If a cloud connection or AI system becomes unavailable, operators may lose access to certain AI-generated information but can fall back on existing plant systems and their own knowledge and training. AI can also improve operator training by allowing personnel to practice responding to scenarios they may never have personally experienced.

Finally, Robins suggested that the community ask chemical plants about how AI is being used, including where AI serves as an advisor versus where it can act independently. He also recommended asking what happens when an AI model produces an incorrect result, who identifies the error and how quickly, and whether any safety systems rely on AI. Other areas of interest include who reviews the models, how often models are retrained or retired, and how the community would be informed if an AI-related failure contributed to an incident.

The CAC is a forum for candid and constructive dialogue between those who live or work in La Porte, Morgan's Point, and Shoreacres and the managers of 41 chemical plants in La Porte. The CAC welcomes visitors. It meets again on Tuesday, September 1 at 6:00 p.m. to hear about the Safety & Emergency Response in Truck and Rail Transportation of Hazardous Materials. Contact info@laportecac.org if you wish to attend. The CAC shares information about its meetings and presentations at www.laportecac.org.