E-CERTIFIER: REVOLUTIONIZING OPERATOR TRAINING AND CERTIFICATION

STAMICARBON

NEXTCHEM
MAIRE Sustainable Technology Solutions

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SUMMARY

1 INTRODUCTION

Operator training is a cornerstone of safety and efficiency in urea production plants, where high-pressure systems and hazardous chemicals like ammonia present significant operational risks. Well-trained operators are essential for recognizing early warning signs of equipment failure, responding swiftly to abnormal conditions, and adhering to strict safety protocols. This not only minimizes the risk of incidents such as toxic leaks, explosions, or environmental contamination but also enhances overall plant reliability. The critical need for comprehensive training is further underscored by the Stamicarbon Incident Database, which documents over 110 real-world incidents from urea plants worldwide. These cases frequently reveal that human error, insufficient maintenance, and inadequate emergency response are recurring factors; many of which could have been prevented through better operator preparedness. By integrating lessons from these incidents into structured training programs, including simulation-based learning and continuous certification, companies can significantly reduce risk, protect personnel and the environment, and ensure long-term operational success.

Traditional training methods, while valuable, often fall short in addressing the dynamic and complex nature of modern industrial environments. Alternatively, e-Certifier is a cutting-edge semi-autonomous operator training and certification system developed by Stamicarbon, the nitrogen technology licensor of NEXTCHEM (MAIRE Group), designed to be adaptable to each client's specific plant and custom Technology Training Simulator, representing a significant leap forward in the realm of industrial training.

E-Certifier leverages advanced simulation technologies and e-learning material to provide a comprehensive training experience that bridges the gap between theoretical knowledge and practical application. By integrating automated scenarios, procedures and quizzes, e-Certifier ensures that operators are not only well-versed in the theoretical aspects of their roles but also proficient in handling real-world scenarios. This innovative approach to training and certification aims to enhance plant operations, improve safety, and ensure that operators are equipped with the skills and knowledge necessary to excel in their roles.

This paper delves into the usage and technical details of e-Certifier, exploring how this revolutionary system can transform operator training and certification in the industrial fertilizer sector.

2 TRAINING METHODS

2.1 Classical training

Currently, operator training is primarily conducted in a classroom setting, which relies heavily on verbal instruction and theoretical knowledge. This method requires the presence of trained instructors, usually plant staff who, in addition to their teaching responsibilities, also have other responsibilities within the plant. These additional obligations can have priority over teaching new personnel, resulting in limited availability of instructors for training sessions.

Other options include hiring external instructors from the licensor, like Stamicarbon, which provides operator training as part of its services. Furthermore, practical skills must mostly be acquired in the field, which is a time-consuming process. Many of the events and scenarios that operators need to train do not occur frequently since plants are becoming increasingly safe and stable, which results in less downtime. This makes it challenging to provide consistent and effective hands-on training. Consequently, the overall process of training new personnel can become lengthy and deplete the availability of essential staff.

In most of the cases mentioned above, a Technology Training Simulator can become a valuable tool.

2.2 Technology Training Simulator

A Technology Training Simulator (TTS) is typically a customized simulator of the client's plant that can be used to train (future) operators. The simulator is a mathematical representation of the plant (see Figure 1), and depending on the client's wishes, the mathematical model will be either connected to an emulation of the control system or a copy of the plant's Distributed Control System (DCS).

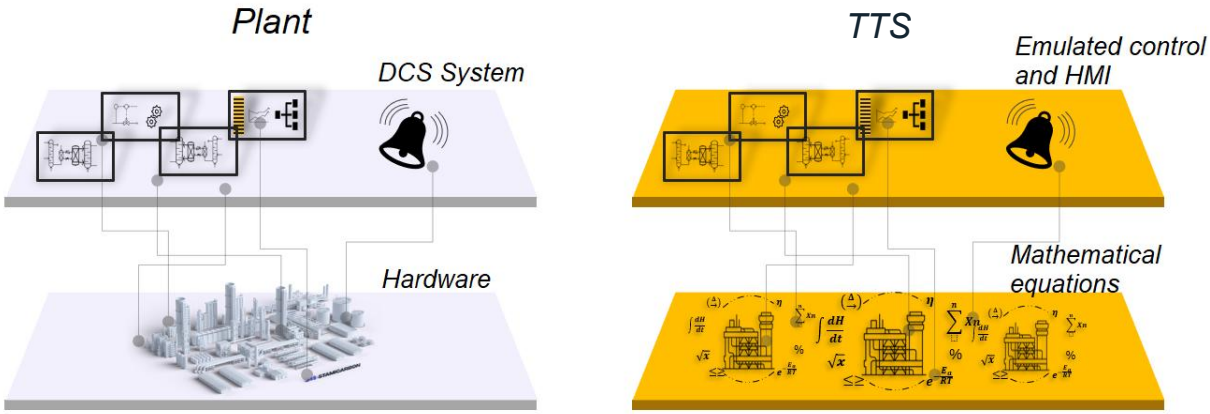

Figure 1: Plant vs. TTS.

Stamicarbon offers tailor-made high-fidelity urea training simulators where the model is based on first principles and includes Stamicarbon's proven thermodynamics and reaction kinetics. The TTS will be developed using client data (P&ID's mass balances, equipment datasheets, etc.) and will accurately represent the client's plant. TTS offers a risk-free training environment where trainees can safely experiment with the process without affecting the actual plant. Besides the mathematical representation of the plant (the model), the TTS also includes the emulation of the DCS and the safety system (Controls, Graphics, Logics, etc.).

The TTS can be used to train operators on the following:

- Start-ups
- Shutdowns
- Load changes
- Infrequent scenarios
- Disturbances

In addition to custom simulators, Stamicarbon also offers generic simulators based on Stamicarbon's plant designs and licensor know-how. Generic simulators provide an economical alternative for plants that do not wish to invest in a customized simulator but still want to leverage the advantages of a TTS. However, it is important to note that generic simulators do not precisely represent the client's plant, which may introduce certain limitations.

Clients who have incorporated a TTS from Stamicarbon into their training programs indicate a significant reduction in the number of training hours required, although precise figures are not available. Other remarks frequently mentioned by clients are:

- The simulator is used to rehearse start-up before starting up the plant after revamping, maintenance, or fully new build. This increases operators' familiarity with and confidence in the operation (which in turn increases the plant uptime and efficiency).
- TTS aids in keeping operator skills up to date.
- Knowledge transfer helps to cope with high operator turnover.
- The simulator is used to assess and train field operators that want to move to the control room.

2.3 Modern way of learning

The current way of training operators relies heavily on classical classroom training, while in the modern era teaching has clearly shifted towards online methods. In all levels of education from primary schools to universities, students log in to a Learning Management System (LMS) portal, select the course(s) assigned to them, carry out examinations online and get a "certificate" of completion. They can train at their own pace and from any location, whether on campus, at home, or in a local coffee bar.

What if the advantages of the modern way of learning in combination with TTS training will apply to operator training too? There is where e-Certifier comes in.

3 E-CERTIFIER

E-Certifier is an integrated training and certification solution designed for the urea industry, combining LMS training with TTS operator training. Trainees will learn theory through LMS courses and apply this theory using a generic Stamicarbon TTS. Practical skills will be developed on the TTS. Knowledge acquired during training will be tested through a theoretical (LMS) exam and a practical exam on the TTS. Successful completion of these assessments results in certification (see Figure 2), hence the name e-Certifier.

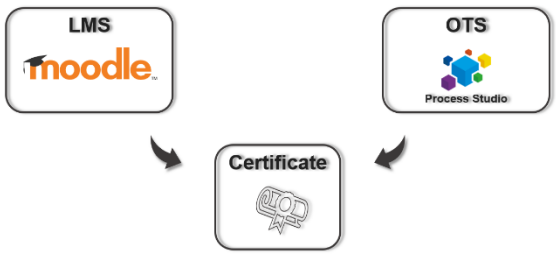

Figure 2: Creation of a certificate.

Although e-Certifier was initially developed for the urea industry, it can be applied to other technologies and industries as well. In future phases, e-Certifier is planned to be extended to other Stamicarbon technologies, such as nitrates and (green) ammonia.

3.1 Process Studio

Process Studio is Stamicarbon's in-house TTS software suite. It comprises several software modules designed to develop, optimize, and run TTS-based training sessions. Process Studio is OPC-compatible, enabling communication with third-party software such as DCS systems, PLCs, or other OPC-compatible software packages. The Process Studio modules most accessed by users are:

- Process Operator
- Process Trainee
- Process Instructor
- Process Scripter

3.1.1 Process Operator

Process Operator is used to debug simulations and create state conditions where the simulated plant can be situated. Common states in a urea plant include:

- 100% Load: Plant operating at full capacity.
- 70% Load: Plant operating below full capacity.
- Cold Start-up: Equipment is switched off, vessels are empty, valves are in their default positions, etc.

3.1.2 Process Trainee

Process Trainee is used by trainees to execute simulations based on training scripts. These can range from small and guided scripts that help trainees familiarize themselves with the process to comprehensive examination scripts that require trainees to solve various scenarios and malfunctions or perform plant start-ups or shutdowns. Scripts can be instructor-guided or fully automated, requiring no instructor attendance.

3.1.3 Process Instructor

Process Instructor is used by the instructor to log in to a trainee session for the purposes of:

- Supporting a session
- Initiating and stopping scenarios or malfunctions (if configured for manual use)
- Intervening in the process

Process Instructor also facilitates reviewing stored sessions and extracting data, such as scoring (if configured), actions performed by the trainee, identifying trends, etc.

3.1.4 Process Scripter

Process Scripter is used to create training scripts for the Process Trainee module.

3.2 Using the LMS

The trainees will log in to the LMS portal, where they will access training courses and select the appropriate course or examination. Each course begins with a theoretical component. Upon completion of the theoretical part, the practical TTS portion will be available. The trainee will select the TTS session in the LMS, which will then initiate the chosen course in the TTS system. TTS will launch automatically with the selected session, as shown in Figure 3.

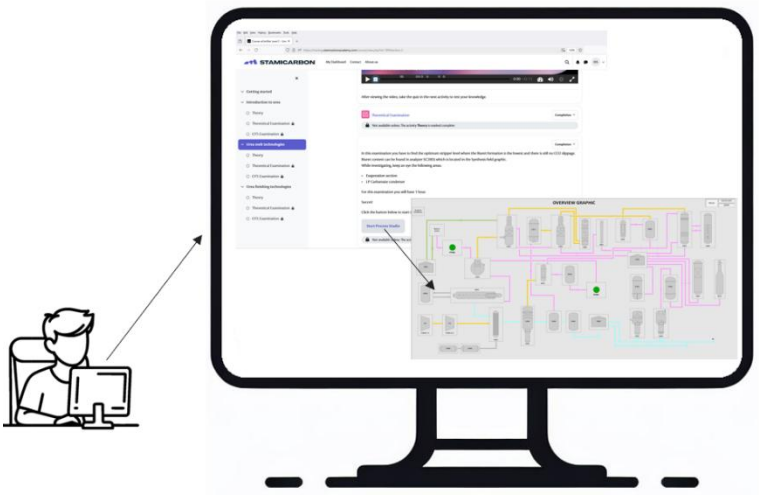

Figure 3: Representation of e-Certifier.

TTS courses distinguish between two types of scripts:

- Automated guided scripts, where the trainee learns the process based on instructions, comments, and hands-on tasks. The script will explain the process using automated interferences (changing setpoints, increasing loads, starting rotating equipment, etc.) and written and spoken instructions. Trainees will witness the effects of the actions performed by the script and at a later stage in the script the trainee must take over and perform some tasks.
- Examination scripts, where the trainee will get a task to complete. This could be, for example, a start-up of a secondary pump, a change in the load of the simulated plant, or recovering from an upset condition. Tasks are aligned with theoretical knowledge acquired from the e-Certifier theoretical module. During the simulation, the script will monitor the trainee's performance, and scoring will be generated after the completed task.

Results from these sessions will be automatically sent to the LMS upon completion. The LMS will integrate these results together with the assessments in the LMS itself into scoring and generating a certificate if passed.

The training coordinator will have access to the LMS and will be able to monitor the trainees' progress and course completion rates through dedicated dashboards and reports.

3.2.1 E-Certifier content

According to data from the Stamicarbon Urea Incident Database, 45% of the 110 documented safety incidents occurred within the synthesis section 26% originated from the feed section, and 13% were associated with the recirculation section (see Figure 4). Additionally, 58% of these incidents were attributed to failures in operation and procedure. Insights gained from these events have enabled Stamicarbon to identify critical focus areas for operators to enhance their knowledge and take effective measures to reduce incident occurrences.

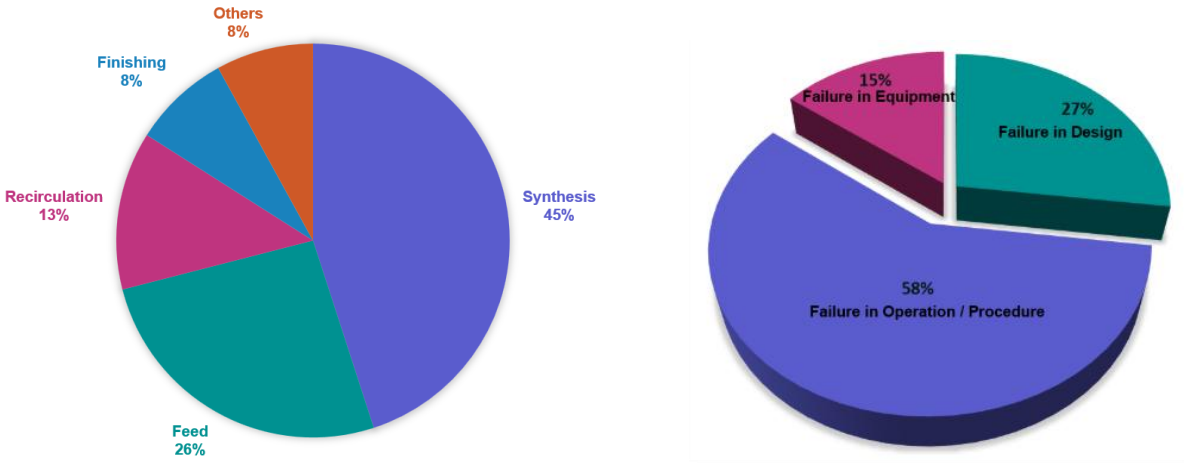

Figure 4: Plant failure analysis.

The Standard e-Certifier has five levels, each with their own courses. The courses are based on the knowledge of the operators. The first levels are designed for newly hired operators where the operator will first learn the basics of the urea process. The following levels are meant to train more experienced operators and will have higher complexity. E-Certifier will have the following content:

- Level 1: Basics of TTS and DCS Operation
    - Process Studio: Learn basic features of TTS/DCS systems, including graphics, faceplates, trends, and alarm manager functions.
    - TTS Features: Understand the plant's interlock system, customization options, and case studies.
    - Operating Tools: Handle PID controllers, ESD, reset, and function buttons.
- Level 2: Urea Basics and Process Description
    - Urea basics, thermodynamics and kinetics
    - High-level process descriptions for urea melt and granulation
- Level 3: Urea Plant Sections (Part 1)
    - Start-up and operation of cooling water, steam system, desorption, evaporation
- Level 4: Urea Plant Sections (Part 2)
    - Start-up and operation of recirculation and synthesis sections
- Level 5: Urea Plant Advanced Course
    - Shutdown of synthesis section
    - Blocking in and restarting plant from blocked-in situation
    - ESD triggering an interlock system

The content mentioned above can be customized according to the customer’s needs and requirements.

4 CONCLUSION

E-Certifier training provides several significant advantages:

- A flexible training environment that allows trainees to train according to their individual situation, regardless of location;
- Interactive and engaging content provided by e-Certifier;
- The ability for instructors to monitor trainees' progress and generate reports on their development;
- Enhancement of operators' skills through e-Certifier, resulting in reduced risk and plant downtime.

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