Sugar Research Australia

FINAL REPORT

AUSTRALIAN SUGAR INDUSTRY TRAINING – DEVELOPMENT OF FACTORY TRAINING MODULES – PHASE 2

FINAL REPORT PREPARED BY	David Moller
CHIEF INVESTIGATOR(S)	David Moller
RESEARCH ORGANISATION(S)	Queensland University of Technology
CO-FUNDER	Queensland University of Technology
DATE	4/5/22
RESEARCH MISSION(S)	PROFITABLE AND PRODUCTIVE

SUGAR RESEARCH INSTITUTE

QUT Queensland University of Technology

Please cite as: Moller, D. J., Australian Sugar Industry Training – Development of Factory Training Modules – Phase 2: Final Report. SRA2019/006. Sugar Research Australia Limited, Brisbane

ABSTRACT

The Australian Sugar Industry Training Learning Management System (ASIT LMS) provides a valuable training resource for the Australian Sugar Industry. As a single location for the milling training programs that have been developed for the last 30 years this provides a great reference resource for operators seeking to solve operating issues during the crushing season.

New on-line operator training programs that have been mapped to the national competencies provide a minimum industry level of knowledge training and assessment for all the raw sugar making processes from juice to sugar storage. Included in the training programs are suitable skills competency assessment checklists that can be undertaken on site by a suitably qualified assessor.

The ASIT LMS also provides a system whereby groups can develop their own internal training courses and use them for internal knowledge assessment activities. This feature is being used by several sugar milling companies to undertake knowledge competency training in areas other than sugar milling operations.

The LMS has been designed to cover all training for the sugar industry. To date there has been limited adoption from the non-milling sector despite the Chief Investigator having made repeated attempts to interest the non-milling sector in using this training platform as the basis of the training for the Australian sugar industry.

The on-line nature of the LMS and the ease of use, combined with its extensive learner tracking and assistance capabilities have provided the Australia Sugar Industry with a knowledge training platform to be used into the future.

EXECUTIVE SUMMARY

A new Learning Management System (LMS) has been developed and is available for use by the Australian sugar industry. The Australian Sugar Industry Training LMS (ASIT LMS) can be accessed at https://asit.anewspring.com. Access to the system is limited to use by people within the Australian sugar industry with the login information being administered by authorised representatives. Specific courses have been developed for all aspects of the production of raw sugar from the extracted cane juice. Additional courses are planned to be developed to cover other aspects of raw sugar milling as funding becomes available.

Being an on-line platform, all access is via the internet. This allows any internet capable device, eg a smart phone, to access any of the training courses. This provides access to the system by most of the sugar industry staff without the requirement to purchase additional hardware.

The new LMS can use all forms of on-line media capabilities in both the content presentation and the assessment processes. Videos and photos are extensively used in the newly developed training courses. Links to appropriate supplier websites are also included to demonstrate the operation and mechanics of specific equipment.

The LMS has been configured so that groups of users are able to be isolated from each other. In this way each milling company has its own sub-environment and can observe the progress of, administer and maintain users from only that company. Separate websites have been setup for each sub-environment so that the user's access to the system appears like their other internal company websites. Courses that are developed by a company are only accessible from within that company. Utilising this feature, some companies have also developed their own courses that they are using for internal company knowledge training and assessment.

Older industry paper-based courses that have been developed in the last 30 years e.g. SRM modules and more recently the SOTrain training programs and the SRI videos have also been made available in the new LMS as reference material for learners. Having all this training and reference material available in one location, accessible from any internet capable device, provides a significant resource for the Australian sugar industry.

When the uptake of the ASIT LMS increases throughout the milling companies, all operators will be able to be trained and their knowledge competency assessed to a minimum industry standard. This training can be undertaken on-line with limited or no supervision, prior to the start of seasonal operations using any internet capable device.

The LMS has been configured for use by all sectors of the Australian sugar industry. To date there has been limited adoption of this learning resource by the non-milling sector. Some of the training opportunities that the LMS can provide for the non-milling sector include:-

1. Harvester training.
2. Haulout training.
3. Best practice courses.
4. Field day courses.

The ASIT LMS provides a valuable training resource for the Australian Sugar Industry. Being a single location for the milling training programs, this provides a great reference resource for operators seeking to solve operating issues during the crushing season. The three new on-line operator training programs that have been mapped to the national competencies provide a minimum industry level of knowledge training and assessment.

The ASIT LMS also provides a system whereby groups can develop their own internal training courses and use them for internal knowledge assessment activities. This feature is being used by several sugar milling companies to undertake knowledge competency training in areas other than sugar milling operations.

The on-line nature of the LMS and the ease of use, combined with its extensive learner tracking and assistance capabilities have provided the Australia Sugar Industry with a knowledge training platform to be used into the future.

CONTENTS

TABLE OF TABLES

1 BACKGROUND

1.1 On-line Training

The Australian sugar milling industry has moved to a new web based on-line training regime. Previously there was no on-line Learning Management System (LMS) that could be utilised by the industry for knowledge competency training and assessment.

The sugar milling sector has developed several training programs in the past 30 years, each of these programs were paper based and not suitable for on-line training. The last of these training programs to be written, SOTrain (Broadfoot, 2015), was originally intended as an on-line training program but the project steering group decided to change this to paper based system during the project. All previously developed training programs were not mapped or written to the national competency standards.

In order to ensure an industry minimum level of training for all sugar milling operators, the ASMC People and Safety committee decided that the national competency standards should be used as the basis for future operator training programs.

Due to increasing demands on staff, representatives from the sugar milling industry indicated that as much training as possible should be undertaken independently from supervision by mill staff. This was a significant departure from the previously developed training program (SOTrain was developed as a mentor, mentee training program). New training material would need to be developed based upon the previous training courses but would need to be modified or re-written to: -

1. ensure that the national knowledge competency standards are satisfied
2. be adapted from a text-based format to an on-line training format using all the available visual options on-line including photos, diagrams and videos and adult learning pedagogies.

1.2 Selection of a Learning Management System operating system

The selection of the Learning Management System (LMS) was not undertaken as part of this project and was facilitated through the ASMC People and Safety committee with funding from SRI. The process was undertaken in this manner so that the industry representatives would determine the LMS platform to ensure that it was able to meet the industry end user needs. The ASMC People and Safety committee was chosen as the assessors of the different LMS platforms to ensure industry “buy-in” to the project. This process was undertaken quickly while the contracting for the project was being finalised with SRA.

The industry selection of the LMS ensured that as many as possible of the industry requirements were able to be met. More than 60 platforms were assessed for suitability for the LMS with a final 6 platforms being rigorously assessed by the ASMC People and Safety committee. From this assessment, aNewSpring was chosen as the successful platform for the Australian Sugar Industry Training LMS (ASIT LMS). It was jointly decided, by SRA, QUT and SRI that SRI should obtain and maintain the contract with aNewSpring. This contract was signed on 15th September 2017.

1.3 Development of training modules

The development of training modules, mapped to the agreed national competency standards, provided a framework for the development of the modules for this project. Modules have been developed for High grade fugals and dryer, Low grade fugals and Crystalliser operation. These modules have been in use throughout the industry and feedback provided by the learners has been incorporated into the development of the new training modules.

2 PROJECT OBJECTIVES

2.1 Development of training courses mapped to the national competencies

As the framework for the training platforms was developed within an earlier project (SRA2017/013), this project was focussed on the development on five new training courses that were mapped to the national competencies. The training courses to be developed in this project are:-

- Juice clarification
- Mud filtration

- Evaporation
- Evaporator cleaning
- Crystallisation

3 OUTPUTS, OUTCOMES AND IMPLICATIONS

3.1 National competency standards

During this project federal government representatives created an industry committee to determine the status of the current sugar industry competency standards. As a result of the discussions within this advisory panel it was agreed that the current sugar industry training competency standards would be “deleted” as they are not currently being used for paid training purposes through a registered training organisation (RTO). This decision was undertaken through a process of rationalisation by the federal government.

The process of deletion means that these competency standards are no longer available for RTOs to assess trainees. Although being “deleted” the competency standards are still available as “archived” standards and thus have been maintained as the basis for the competency standards on which the training material for this project was based.

3.2 Training modules

The training modules that have been developed during this project include:-

- Juice clarification
- Mud filtration
- Evaporation
- Evaporator cleaning
- Crystallisation

This provides a full suite of training materials for the raw sugar production stream within a raw sugar factory from juice through to crystallisation and sugar storage.

The current courses that are available within the Australian sugar industry training learning management system that have been mapped to the national competencies are shown in Table 3.1.

Table 3.1 Training courses mapped to the national competencies

Training courses mapped to the national competencies
Traffic officer
Juice clarification
Mud filtration
Evaporation
Evaporator cleaning
Crystallisation
High grade fugals and sugar drying
Low grade fugals
Cooling crystallisers

3.3 Outcomes and Implications

To date there has been limited use of the training course modules as management at the factories appears to have decided to wait until the full suite of “process” courses was available for use. It is expected that now the courses cover all aspects of the “process” sugar operations that the use of the training courses will increase throughout the industry.

4 INDUSTRY COMMUNICATION AND ENGAGEMENT

4.1 Industry engagement during course of project

One unexpected outcome of the development of the ASIT LMS is that some Australian sugar factories are using the system as their primary training LMS. Two current sugar milling businesses are using the ASIT LMS for their contractor induction training and recording.

Mackay Sugar (MSL) is also using the ASIT LMS as the primary training platform. MSL is using the ASIT LMS for the development of their own training material for specific training activities including employee inductions and fire safety. MSL has developed a total of 24 training courses that they are using to train and assess their employees.

4.2 Industry communication messages

During the QUT/SRI face to face training courses that are held each year, the benefits of the on-line training LMS are demonstrated during the training courses. This reaches a large section of the milling employees e.g. in 2022 there were 284 individual attendees undertaking training at these courses for a period of 430 man-days. The benefits of the on-line LMS will continue to be demonstrated at these courses each year.

5 METHODOLOGY

5.1 Training course development

The industry training courses that have been developed within this project have each followed the same development path which was developed within the previous SRA project (SRA2017/013). Each of the following six steps take place to ensure a robust, industry approved training course is developed.

5.2 Training course content matrix

A training course matrix is developed within a spreadsheet that describes how each of the defined national competencies will be presented and assessed within the training course. The matrix also includes some brief details about photos and videos that may be used within the training course material. When the matrix has been thoroughly checked it is provided to the industry representatives for comments. The feedback usually provides small additional details on what the industry would like included in the training material content. The matrices are shown in Appendix 2,3,4,5 and 6 to show the level of detail each matrix covers.

5.3 Training course content development

As defined in the training course matrix, the training course content and questions are developed in the ASIT LMS. The content includes text instructions, diagrams, videos and many photographs taken from throughout the Australian Industry. The training course material is developed in such a way that the content can be used in all platforms that are able to access the internet. Checks are made to ensure that the course content is following a logical order when viewed on a smaller phone screen, compared to the different layout when seeing the same content on a larger landscape-based computer screen.

The content is based upon many references including texts, previous training course material and presentations used in industry face to face training courses.

All the course content defines specific terms to ensure a common meaning and understanding throughout the industry. These terms may be subtly different to the terms used at some sites, but a common language is important to develop and maintain throughout the industry. The language level of the content is aimed at Certificate 3 to maximise the knowledge transfer to people that have limited reading and language skills.

5.4 Course content review

The course content is reviewed by a subject matter expert to ensure that the content is correct. This process includes cross checking that each question is clearly covered by a corresponding piece of content. The content is cross checked to ensure that common instructions are reinforced through the on-line LMS and at the industry face to face training courses.

5.5 Training course template development

Arranging the content into a course that will provide the maximum knowledge transfer to the learner is the art of developing the course template. The standard design for the industry courses is to have up to 5 pages of information followed by a quiz question that seeks to re-enforce the key learning objectives of the content just covered. The answers for each of the quizzes are recorded but the mark is not used in the final assessment.

Included in each training course is a skills competency checklist based on the national competency requirements. This checklist can be used by a suitably trained assessor to assess the skills of each operator, providing both the knowledge and skills competency requirements, based on the national guidelines.

5.6 Pre-release training course testing

Before release to the industry the course is fully tested to ensure the leaning process is smooth and seamless. Different users are provided access to the test course so that different learning methods can assess the training course. The assessment process is thoroughly tested to ensure that the only way a certificate is issued is when each learner has passed the necessary assessment levels. This is currently set at 100% of the (five) safety questions and 80% for the (twenty) general knowledge questions.

5.7 Industry training course testing and review

When the course has been thoroughly tested and all the bugs within the course resolved, a copy of the course is made for each sub-environment for their internal use. An email notice is sent to the sub-environment administrators to inform them that they may now enrol learners in the newly available course.

It should be noted that although all the courses are available for use by all of the users within the Australian sugar industry, it is a decision of the sub-environment administrators which courses are most appropriate for which users. This process is designed to ensure that the learners do not feel overwhelmed by having too many courses, some of which would be of limited interest and value.

6 RESULTS AND DISCUSSION

6.1 Users

As at 1/4/22 there are 1644 unique users using the system within the Australian sugar industry. This includes 712 uses that are not associated with Mackay Sugar. There also have been 2824 contractors that have used the ASIT LMS to successfully undertake a contractor induction before being allowed on site at two Australian sugar milling companies. The number of visits to the LMS since the development of the system is shown in Figure 6.1.

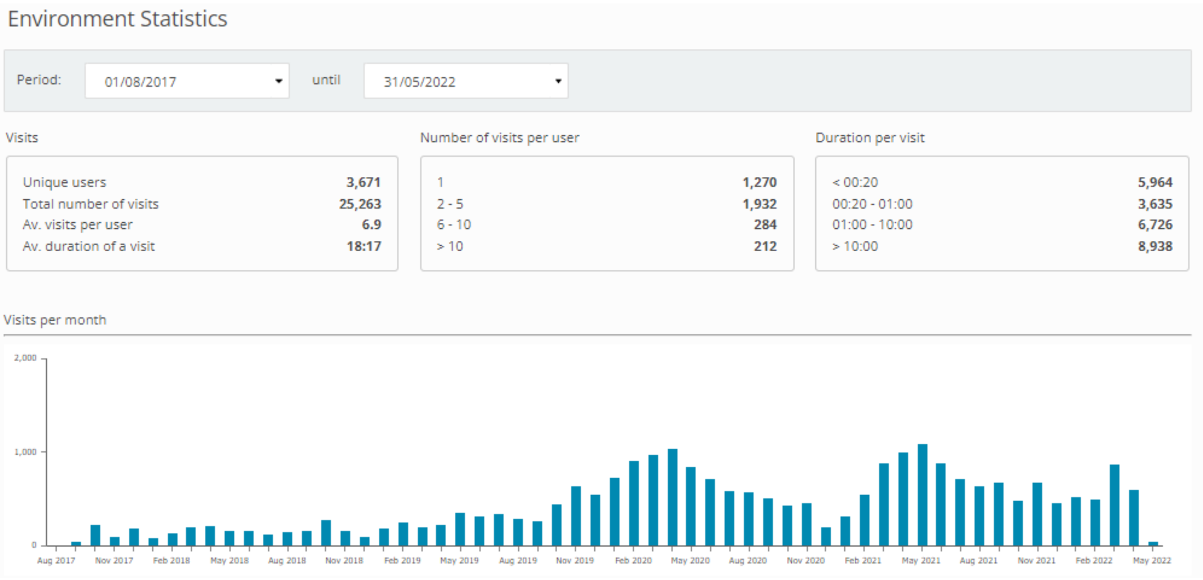


Figure 6.1 Number of visits to ASIT LMS by month

As can be seen in the graph in Figure 6.1 there has been a general increase in usage of the LMS in the past 2 years. This is expected to continue now that a complete career path of training courses is available for use.

6.2 Documentation

Each of the training courses is made from individual web “pages” of information. These pages may contain text, images, and links to videos. There are currently 4,131 pages of documentation from which all the training courses within ASIT LMS can be accessed.

6.3 Usage

To date there has been a total of 3,775 hours on-line used by members of the Australian sugar industry (excluding the developers David Moller and Bruce King). There has also been a total of 2,767 hours online used by contractors using the ASIT to satisfy the induction requirements for two Australian sugar milling businesses.

7 CONCLUSIONS

The Australian Sugar Industry Training Learning Management System provides a valuable training resource for the Australian Sugar Industry. As a single location for the milling training programs that have been developed for the last 30 years this provides a great reference resource for operators seeking to solve operating issues during the crushing season.

A suite of new on-line operator training programs that have been mapped to the national competencies provides a minimum industry level of knowledge training and assessment. Included in the training programs are suitable skills competency assessment checklists that can be undertaken on site by a suitably qualified assessor. Both assessments can be used as evidence to the national competency standard.

The ASIT LMS also provides a system whereby groups can develop their own internal training courses and use them for internal knowledge assessment activities. This feature is being used by several sugar milling companies to undertake knowledge competency training in areas other than sugar milling operations.

The LMS has been designed to cover all training for the sugar industry. To date there has been limited adoption by the non-milling sector despite the Chief Investigator’s attempts to interest this sector.

The on-line nature of the LMS and the ease of use, combined with its extensive learner tracking and assistance capabilities have provided the Australia Sugar Industry with a knowledge training platform to be used into the future.

8 RECOMMENDATIONS FOR FURTHER RD&A

As based on the requests by industry further courses can be developed for other aspects of the sugar milling operation. These include milling operations, mill setting, cane preparation, laboratory skills, boiler operation. These courses will continue to be developed in conjunction with industry when funding becomes available.

The LMS was developed for use by the Australian sugar industry but to date has only be utilised by the milling sector. Despite repeated discussions with SRA and Canegrowers it is disappointing that this industry resource remains to be underutilised by these significant industry representatives.

9 PUBLICATIONS

To publicise the features and availability of the ASIT LMS several publications have been presented to the Australian Society of Sugar Cane Technologists. These papers and presentations include (Moller, D. J., King. B., 2018), (Moller, D. J., King. B., 2019), and (Moller, D. J., King. B., 2020).

10 ACKNOWLEDGEMENTS

Continued assistance, comment and direction provided by the industry steering group have greatly assisted in the success of this project. The group’s commitment of time in assisting this project is gratefully acknowledged.

11 REFERENCES

Broadfoot, R. Godat, M. &. Kent. G. A., 2015. *SOTrain: A new program for training supervisors and operators in Australian sugar factories.* Proceedings of the Australian Society of Sugar Cane Technologists V 37, p 267-277, Bundaberg, QLD,

Moller, D. J., King. B., 2018. *Australian sugar industry training learning management system*. Proceedings of the Australian Society of Sugar Cane Technologists, V 40 p 24-32. Cairns, QLD.

Moller, D. J., King. B., 2019. *Adoption of the new on-line training platform for operator training.* Proceedings of the Australian Society of Sugar Cane Technologists, V 41, p 182, Mackay, QLD.

Moller, D. J., and King, B., 2020. *The Australian Sugar Industry Training (ASIT) Learning Management System (LMS).* Proceedings of the Australian Society of Sugar Cane Technologists, V 42, p 21, Toowoomba, QLD.

12 APPENDIX

12.1 Appendix 1 METADATA DISCLOSURE

TABLE 12.1 METADATA DISCLOSURE 1

Data	On-line training materials
Stored Location	https://asit.anewspring.com/
Access	Restricted – Members of the Australian sugar industry
Contact	Bruce King <b.king@sri.org.au>

12.2 Appendix 2 - Clarification Heating Liming Floc content Matrix

Element / (*code*)	Performance Criteria	Required knowledge	Required Skills	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
Overview of Clarification Heating Liming Floc *0.1*		The circuit flow of this process and relationship to related processes terminology relating to Clarification Heating, Liming, Floc		Clarification Heating Liming Floc station overview. Written description with photos. Video/presentation of the sugar process and where the Clarification, Heating, Liming, Floc sit.	Terminology. What an operator can influence. What the Clarification Heating, Liming Floc station is trying to achieve How a very good Clarification Heating, Liming Floc station and operator will function. PPE specific to the Clarification Heating, Liming Floc station. terminology such as brix , pH, dosing, flocculant, lime, dextran, starch, milk of lime, saccharate.	Flow chart of inputs output, machinery, in an ideal set up. Photos of mixed juice tank, inputs, primary and secondary heaters, incubators, flash tank, clarifier, liming, flocculation.	Aim of the Clarification, Heating, Liming, Floc station Parameters an operator can and cannot influence Parameters and set points why upper and lower limits Flow diagram of Clarification, Heating, Liming, Floc station Glossary terms SOP's	
0.2	PPE, hazards and site safety	Purpose and limitations of protective clothing and equipment		Select, fit and use personal protective clothing and/or equipment Additional hazards involved with the station	High temperature fluids, pipes and machinery High temperature steam Hot water for cleaning. Lubricants. Hot pipes and surfaces. Moving cams and drives. Electrical circuits. Flow valves, restrictors, tanks.	Pictures of the key elements with discussion, burns entanglement.	PPE specific to Clarification, Heating, Liming, Floc station Hazards specific to LG Clarification, Heating, Liming, Floc station On site safety resources eg First aid kit, eye wash, shower SDS relevant to Clarification, Heating, Liming, Floc station	
0.3	Work is carried out in accordance with company policies and procedures, licensing requirements, manufacturer's recommendations, legislative requirements, codes of practice and industrial awards and agreements.			Equipment and plant that is used at the Clarification, Heating, Liming, Floc station	Clarification, Heating, Liming, Floc station equipment may include: ▪ Mixed juice tank ▪ Primary heaters ▪ Incubator or 2nd mixed juice tank ▪ water and steam system ▪ Lime preparation ▪ Secondary heaters ▪ Flash tank ▪ Flocculation preparation and addition ▪ Clarifier	Individual pictures of the key elements	Detailed diagrams/photos of equipment in Clarification, Heating, Liming, Floc station	
1 Prepare the clarification process for operation *1.1.1*	1.1 (added to criteria) Purpose and basic principles of clarification. This includes heating, liming, juice degasification and flocculant addition	Equipment purpose and basic operating principles of juice clarification equipment Include; The function of the incubation tank and starch removal (include plug flow and residence time)		Materials including raw juice to be clarified	Equipment purpose and basic operating principles of Clarification, Heating, Liming, Floc equipment Purpose and basic principles of Clarification, Heating, Incubation, Liming, Floc station operation including Inputs, operating efficiencies for Clarification, Heating, Liming, Floc station. Quality characteristics of raw juice and of clarified products.		Equipment purpose and basic operating principles of Clarification, Heating, Liming, Floc equipment Purpose and basic principles of Clarification, Heating, Incubation, Liming, Floc station operation including Inputs, operating efficiencies for Clarification, Heating, Liming, Floc station.	

Element / (*code*)	Performance Criteria	Required knowledge	Require d Skills	Requirements for LMS	Key points	Photos/Videos/Di agrams	Course Outline	Content and quiz
1.2.1	1.2 (1.1 in criteria) Raw juice is and available to meet production requirements	The effect of input into the mixed juice tank and the overall performance of the clarification station The effect of recycle streams on the clarification process Quality characteristics of raw juice and of clarified product Conditions that can cause deterioration in juice The impact of dextran on sugar quality			Checks required prior to start up Clarification, Heating, Liming, Floc station Visual and DCS checks SOP Communication with extraction operator, effet operator, pan operator and Shift supervisor	Mixed juice tank full, filling and empty	Product and process specifications and operating parameters	
1.3.1	1.3 (added to criteria) Prepare lime, flocculant and saccharate for addition	Preparation procedures for MOL, Lime saccharate, floculant Effect of faulty preparation of materials		Confirm supply of necessary materials; lime and lime saccharate, floculant Materials including saccharate, floc and services as required	Preparation procedures for MOL, Lime saccharate, floculant Look at lime preparation in detail. Low solubility, exothermic reaction, preparation time, usable life, safety precautions, MOL to lime saccharate. Flocculant preparation. Dissolving, clean water and at correct temperature, pH, safety, preparation time, storage time, disposal if not used	Lime powder, lime plus water, MOL, saccharate, Floc powder, floc addition, floc mixing, floc consistency	Preparation procedures for MOL, Lime saccharate, floculant Look at lime preparation in detail. Low solubility, exothermic reaction, preparation time, usable life, safety precautions, MOL to lime saccharate. Flocculant preparation. Dissolving, clean water and at correct temperature, pH, safety, preparation time, storage time, disposal if not used	
1.3.2		The purpose and role of materials added Materials can include lime, flocculants, enzymes, phosphoric acid, saccharate and preservatives		Basic chemistry of what MOL and Floc do in terms of impurity removal from juice	The details of why we use lime and floc and their specific role in the process during this stage and downstream stages	ESJ,	The details of why we use lime and floc and their specific role in the process during this stage and downstream stages	
1.3.3		The effect of addition rates on the process			What measurable and visual qualities to check to validate addition rates		What measurable and visual qualities to check to validate addition rates	
1.4.1	1.4 (1.2 in criteria) Services are confirmed as available and ready for operation	Services used Conducting relevant pre-start checks Services as required		Confirm supply of necessary materials and services, this will include steam, hot water Confirming equipment status involves conducting relevant pre-start checks, confirming that cleaning standards are met, all	Services may include: ▪ power ▪ water ▪ steam ▪ compressed and instrumentation air.	Operator on two way/m ph DCS showing availability of steam, hot water, power	Communication with extraction, effets, pans/shift supervisor and other operators. Checking of shift log Check DCS, lab reports, Shift logs and trends, Production Reports, Communication boards, shift supervisor and production managers recommendations	

Element / (*code*)	Performance Criteria	Required knowledge	Required Skills	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
				safety guards are in place and equipment is operational. It may also involve checking operation/calibration of measuring instrumentation	Liaise with other work areas What to look for. Checking of prior entries to log book			
1.5.1	1.5 (1.3 in criteria) Equipment is checked to confirm readiness for use	Conducting relevant pre-start checks all safe guards are in place Lock out and tag out procedures		Confirm equipment status and condition Visual and DCS checks	What to look for. Checking of prior entries to log book	Clarification station has all systems ready for startup Materials including saccharate, floc and services as required	What is the current crushing rate, imbibition addition and required throughput for the clarification station.	
1.5.2		Equipment is operational		List with photos Juice clarification equipment	Clarification, Heating, Liming, Floc station equipment may include: ▪ Mixed juice tank ▪ Primary heaters ▪ Incubator or 2nd mixed juice tank ▪ water and steam system ▪ Lime preparation ▪ Secondary heaters ▪ Flash tank ▪ Flocculation preparation and addition ▪ Clarifier	Individual pictures	Detailed diagrams/photos of equipment in Clarification equipment may include tanks, juice pumps, juice heaters, flash tank, lime storage and mixing plant, saccharate tank, flocculant addition system, clarifier	
1.61	1.5 (1.4 in criteria) The clarification station is set up to meet production requirements	Monitor supply and flow of materials to and from the process		Schedule for production rate is organised and required throughput and quality is forwarded to evaporator station. (ESJ)	Schedule is continuous, maximising throughput. Access workplace information to identify production requirements	Clarification throughput per hour	Mixed juice tank, lime, incubation period, floc, temperatures, flashing and clarification to meet factory throughput	
1.6.2		Basic operating principles of process control where relevant. This includes the relationship between control panels and systems and the physical equipment		Operating procedures and related advice on equipment operation including advice on safe work practices and environmental requirements	Operation and monitoring of equipment and processes typically requires the use of control panels and systems	DCS, various screens with different depth of details	Operating procedures and related advice on equipment operation including advice on safe work practices and environmental requirements	
2 Operate and monitor the clarification process *2.1.1*	2.1 The clarification process is started up and operated according to company procedures	Follow start up procedure		Workplace information can include Standard Operating Procedures (SOPs), specifications, production schedules and manufacturer's specifications	Confirm equipment status and condition Access workplace information to identify production requirements	Logs, current production requirements	Flow chart of startup	
2.1.2		Set up and start up the process in both automatic and manual modes		Auto Manual Start up Sequencing	Startup SOP's Power, hot water, steam availability		Flow cart of startup sequence for clarification station. Standard procedure for Manual and auto start up.	

Element / (*code*)	Performance Criteria	Required knowledge	Required Skills	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
2.1.3		Work is carried out in accordance with company policies and procedures, licensing requirements, manufacturer's recommendations, and legislative requirements, codes of practice and industrial awards and agreements.		Check any related mill industry policies, awards, codes of practices that are specific to clarification station, including lime and floc handling	Look for any key points	PowerPoint of relevant information	Industry related award and policy. SOP's	
2.2.1	2.2 Control points are monitored to confirm performance is maintained within specification	Monitor the process and equipment operation to maintain the process within the required parameters. This typically involves visual inspections and conducting tests to monitor characteristics such as: juice temperatures steam pressure condensate flow and quality throughput juice pH ESJ turbidity addition rates raw juice quality clarifier mud levels and quality equipment condition		Set points, parameters, throughput, dosing, pH	Deviation outside of set point parameters and cause and recommended procedures for rectification	DCS photos, set point photos	DCS set points. High and low values. Control mechanisms. Visual checks that set point are being achieved.	
2.2.2		Operating requirements and parameters		Set points, parameters, throughput	Deviation outside of set point parameters and cause and recommended procedures for rectification The effect of variation in process parameters	DCS photos, set point photos	DCS set points. High and low values. Control mechanisms. Visual checks that set point are being achieved.	
2.2.3		Significance and method of monitoring control points within the process		Control points v's set points	Controls that the operator can and cannot change	DCS photos, set point photos	DCS set points. High and low values. Control mechanisms. Visual checks that set point are being achieved.	
2.2.4		Control points refer to those key points in a work process that must be monitored and controlled.		Control points v's set points	Controls that the operator can and cannot change	Photos of key control applications	DCS set points. High and low values. Control mechanisms. Visual checks that set point are being achieved.	
2.2.5		Safety Data Sheets(SDS) where appropriate		Any chemicals used in cleaning, lubricants, lime, flocculant	SDS relevant titles only as data can change	SDS photo with relevant title but blurred information	Detailed diagrams/photos of equipment in clarification station	

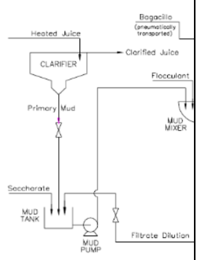
Element / (*code*)	Performance Criteria	Required knowledge	Require d Skills	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
2.3.1	2.3 Clarified product meets specifications	Monitor the process and equipment operation to maintain the process within the required parameters. This typically involves visual inspections and conducting tests to monitor characteristics such as: • Juice temperatures • steam pressure • condensate flow and quality • throughput • juice pH • ESJ turbidity • addition rates • raw juice quality • clarifier mud levels and quality • equipment condition		Mixed juice qualities, saccharate material and mixing, flocculant material and mixing in sugar	Monitor supply and flow of materials to and from the process	Video and pictures of juice, lime, floc, ESJ, v qualities	Monitor supply and flow of materials to and from the process Effect of delays/stops	
2.3.2		Factors that affect throughput and recovery including the access to workplace information to identify production requirements		Scheduling, +4 hrs, +8hrs	Access workplace information to identify production requirements		Schedule for current and forecast production rate relevant to current throughput and juice quality.	
2.3.3		Take samples and conduct tests • SUG202A Collect and prepare samples • SUG213A Perform standard tests on a cane sample • FDFOP2030A Operate a process control interface.		Need to look at what is relevant from these documents			Sampling and testing procedures	
2.3.4		Production schedules		Scheduling, +4 hrs, +8hrs	Variations that may occur	DCS schedules	Schedule for current and forecast production rate relevant to Current and foreseeable future throughput rate	

Element / (*code*)	Performance Criteria	Required knowledge	Required Skills	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
2.3.5		Control station throughput to meet factory throughput				Cut to crush to raw sugar.	Operation all details during operation	
2.3.6		Factors that affect throughput			Mixed juice qualities including imbibition, filtrate, cane quality (eg stale), pH, floculant prep and addition, temperatures, flashing		Mixed juice qualities including imbibition, filtrate, cane quality (eg stale), pH, floculant prep and addition, temperatures, flashing	
2.4.1	2.4 Equipment is monitored to confirm operating condition	Use process control systems			DCS, screens, levels, valves, temperatures, supply and flows	DCS	DCS, screens, levels, valves, temperatures, supply and flows	
2.4.2		Manufacturer's specifications			Product and process specifications and operating parameters		Manufactures recommendations v's SOP's	
2.4.3				Doc with photos	Clarification systems	Photos	Clarification systems	
2.4.4		Hazards and controls		Doc with photos	Various hazards and controls Guards	Photos of hazards. Heat shield on heaters	Detailed diagrams/photos of equipment in clarification systems	
2.4.5		Operation and monitoring of equipment and processes typically requires the use of control panels and systems.		Doc with photos	DCS	Video of changes being made to a DCS	DCS changes and comparing to visual changes and lab results to see that changes are being achieved	
2.5.1	2.5 Out-of-specification process and equipment performance is identified, rectified and/or reported according to workplace reporting procedure	Take corrective action in response to out-of-specification results		Doc and flow chart	Various out-of-spec process and performance described	Flow chart of what to do depending on the severity of the issue	Clarification systems corrective actions plus flow chart of course of action dependent on situation	
2.5.2		Common causes of variation and corrective action required			Variations, leaks, noise, valves	using all available controls and human senses, eyes, ears, feel	Clarification systems cleaning cycle corrective actions plus flow chart of course of action dependent on situation	
2.5.3		Report and/or record corrective action as required		The importance of the log and the records	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	Typical log entries	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	
2.5.4		Record workplace information		The importance of the log and the records	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	Typical log entries	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	
2.5.5		Procedures and responsibility for reporting problems		The importance of the log and the records	Log books both manual and electronic, type of information required eg time,	Typical log entries	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	

Element / (*code*)	Performance Criteria	Required knowledge	Required Skills	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
					issue, who reported to, actions, follow up, rectification			
2.5.6		Environmental issues and controls		Refer to general site induction and policies Advice on environmental management issues relevant to work responsibilities	Mill policies, Regulations	Ponds, cooling towers, trenches/channels, spills	Mill policies, Regulations for lime, flocculants, enzymes, phosphoric acid, saccharate, preservatives, trenches/channels, spills as related to clarification system	
2.5.7		Waste handling requirements and procedures		Refer to general site induction and policies	Mill policies, Regulations	Video of techniques used	Mill policies, Regulations for lime, flocculants, enzymes, phosphoric acid, saccharate, preservatives, trenches/channels, spills as related to clarification system	
2.5.8		Lock out and tag out procedures		Refer to general site induction and policies	Mill policies, Regulations	Flow diagram and pictures of tags and locks	Mill policies, Regulations for lime, flocculants, enzymes, phosphoric acid, saccharate, preservatives, trenches/channels, spills as related to clarification system	
2.6.1	2.6 The workplace meets housekeeping standards	Housekeeping standards and procedures		Control area or room, clarification station	Neat, tidy, stocked with required equipment, no clutter from personal items from shift to shift	Pictures of the good the bad and the ugly	Control room and general set up and organisation	
2.6.2		Maintain work area to meet housekeeping standards		Control area or room, clarification station	Neat, tidy, stocked with required equipment, no clutter from personal items from shift to shift	Pictures of the good the bad and the ugly	Control room and general set up and organisation	
2.6.3		Confirming that housekeeping standards are met		Control area or room, clarification station	Neat, tidy, stocked with required equipment, no clutter from personal items from shift to shift	Pictures of the good the bad and the ugly	Control room and general set up and organisation	
2.7.1	2.7 Workplace information is recorded according to workplace recording requirements	Record workplace information						
3 Handover the clarification process *3.1.1*	3.1 Workplace records are maintained in accordance with workplace procedures	Workplace information recording systems, requirements and procedures.		Doc explaining the importance of changeover log	Time, what happened in lead up to issue, issue, who contacted, follow up, current situation, further monitoring. Legibility, clear concise information	Log books written and electronic	Recording of information during shift. Time, what happened in lead up to issue, issue, who contacted, follow up, current situation, further monitoring. Legibility, clear concise information	
3.1.2		Recording requirements and procedures		Doc explaining the importance of changeover log	Time, what happened in lead up to issue, issue, who contacted, follow up, current situation, further monitoring	Pictures or power points of operator/shift supervisor/electrician etc discussing an issue and log book data recording	Recording of information during shift, Time, what happened in lead up to issue, issue, who contacted, follow up, current situation, further monitoring. Legibility, clear concise information	
3.2.1	3.2 Handover is carried out according to workplace procedure	report and/or record corrective action as required		Mill logs, verbal communication	Importance of standard procedure on delivery of information at change over via log books, verbally and visually	Mill commonly used procedure in a flow chart	Hand over, what is expected, details, verbal and written communication, scheduling for next 4 to 8 hrs that may impact on throughput	

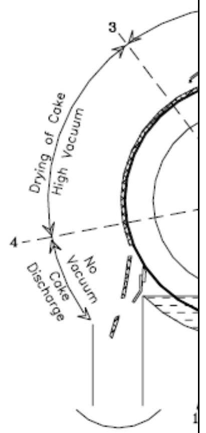
Element / (*code*)	Performance Criteria	Required knowledge	Require d Skills	Requirements for LMS	Key points	Photos/Videos/Di agrams	Course Outline	Content and quiz
3.2.2		Recording requirements and procedures		Mill logs, verbal communication	Importance of standard procedure on delivery of information at change over via log books, verbally and visually	Mill commonly used procedure in a flow chart	DCS displays and trends during shift	
3.3.1	3.3Clarification operators are aware of system and related equipment status at completion of handover	Record workplace information		Questioning and understanding that shift handover information has been transmitted and received	Checking by both the person finishing a shift and the new operator that both are satisfied that all relevant information has been given and understood	Video of discussion at handover showing both log book and issue	Questioning by new operator of written and verbal instructions to check complete understanding of all instructions	
3.3.2		Recording requirements and procedures		Questioning and understanding that shift handover information has been transmitted and received	Checking by both the person finishing a shift and the new operator that both are satisfied that all relevant information has been given and understood	Video of discussion at handover showing both log book and issue	Questioning by new operator of written and verbal instructions to check complete understanding of all instructions	
4 Shut down the clarification process *4.1.1*	4.1 The appropriate shut down procedure is identified	Demonstrate (understand) an operational shut down procedure		Flow diagram and why order of shut down is important. Auto and manual	Order of shut down DCS and visual inspections		Manual and auto shut down of clarification system in a controlled shut down. DCS and visual inspections	
4.1.2		Shut down equipment in response to an emergency situation		Types of emergencies and where and what operator can do	Life, fire, vibration, overfilling, hot water or steam leak, torn screen,	Stop options available depending on the situation	Emergency stop or shutdown. Causes of shutdowns.	
4.2.1	4.2 The clarification system is shut down according to workplace procedures	Shut down and clean clarification system according to schedule or as indicated by equipment monitoring		Doc + Photos	Prepare equipment for cleaning/ maintenance Clean and sanitise equipment	Pictures of various parts of the clarification system	SOP's of shut down and visual inspections of proceedings	
4.2.2		Shut down and clean clarification system according to schedule or as indicated by equipment monitoring		Procedures, inspections, communication Cleaning and sanitation procedures	continuous	Clarification system pictures of cleaning	SOP's of shut down and visual inspections of proceedings	
4.3.1	4.3 The clarification system is prepared for storage in shut down mode	Requirements of both operational and long term shut down conditions to ensure the equipment is left in a safe state for the period of the shutdown and to minimise any delays in future start up		Doc + Photos	Checks required prior to maintenance season schedule		Shut down and storage of clarification system	
4.4.1	4.4 Maintenance requirements are identified and reported according to workplace reporting procedure	Recording requirements and procedures		Importance of the log and the records	Issues and maintenance program identified in consultation with appropriate staff from seasons log book issues and schedules	Pictures of discussions around clarification system	Checks of all equipment and documentation of required maintenance	

12.3 Appendix 3 - Mud Filters content matrix

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/ Diagrams	Course Outline
Overview of Mud Filters *0.1*		The circuit flow of this process and relationship to related processes terminology relating to clarification, mud mixer, mud filter and filtrate. the circuit flow of this process and relationship to related processes including mud output, filter speed, water addition and cake permeability the purpose and basic principles of mud filtration	Mud Filters station overview. Written description with photos. Video/presentation of the sugar process and where the Mud Filters sit. Flow Chart	Terminology. What an operator can influence. What the Mud Filters station is trying to achieve How a very good mud filtration process will operate PPE specific to the Mud Filters	Flow chart of inputs output, machinery, in an ideal set up.	Aim of the Mud Filters Parameters an operator can and cannot influence Parameters and set points why upper and lower limits Glossary terms SOP's The main aims of the filter station are: To remove mud solids from the process with a minimum loss of sugar (sucrose). To return filtrate (the liquid remaining after the mud solids have been filtered off) to process with a minimum quantity of retained mud solids. To return filtrate to process with a minimum amount of added wash water. Filter operation is vital to overall factory performance because any sugar lost in the filter mud is lost from the process. There are no subsequent processing steps which offer the opportunity to recover the sugar if the filters are not performing well.
0.2	Work is carried out in accordance with company policies and procedures, licensing requirements, manufacturer's recommendations, legislative requirements, codes of practice and industrial awards and agreements.	purpose and basic principles of mud filtration process	Equipment and plant that is used at the Mud Filters station	Mud filtration equipment may include: ▪ clarifier mud removal ▪ mud tank/mud mixer ▪ bagacillo system (from rotary juice screen and/or from final bagasse) ▪ filtrate receivers and pump ▪ vacuum pumps/ condenser ▪ mud filter (rotary drum filter or horizontal vacuum belt filter) ▪ mud conveying system and storage ▪ filter wash water supply ▪ lime, flocculant and filtrate recycle to mud system. ▪	Individual pictures of the key elements 	Detailed diagrams/photos of equipment in Mud Filters
1 Prepare the Mud Filters station for operation *1.1.1*	1.1 Assess and condition mud to meet filtration requirements	What is normal condition for good operation.	Confirm supply of necessary materials and services	Checks required prior to filling of Mud Filters Visual and DCS checks SOP Communication with d Shift supervisor	Mud moving into the mud mixer	Mud levels, quantity required throughput. Pre checks visual, DCS, safe guards in place, communication with Shift supervisor and other operators. Checking of shift log Walk past all equipment at start of shift/ start up Handover at start of shift Sugar leaving the factory in mud is money leaving the factory. The rotational speed of the filter and the amount of wash water applied to the cake have a major effect on filter performance.

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/ Diagrams	Course Outline
1.2.1	1.2 Confirm services are available and ready for operation (Note 1.2 and 1.3 should be one section not two)	Conducting relevant pre-start checks	Confirm equipment status and condition Visual and DCS checks	What to look for. Checking of prior entries to log book	Operator on two way/m ph DCS showing availability of cold water (injection water), hot water, and power	What is the current required through put and how many filters are required to be operational to optimise process of mud filters
1.3.1	1.3 Check equipment in readiness for use according to operating specifications	Conducting relevant pre-start checks all safe guards are in place equipment is operational	Confirm equipment status and condition Visual and DCS checks	What to look for. Checking of prior entries to log book	Mud Filters start up from empty boot and start up from full	Prechecks could include screen damage, scrapers and relative position, sampler if used, bagacillo system, vacuum, boot level.
1.3.2		equipment purpose and basic operating principles of mud filtration equipment including vacuum pumps and condensers the purpose and role of materials added and their effect on filter operation	List with photos	Mud filtration equipment may include: ▪ clarifier mud removal Ideally, mud should be withdrawn continuously from the cone of the clarifier rather than intermittently. Continuous withdrawal should result in the primary mud having a more consistent quality. ▪ mud tank/mud mixer Mud Conditioning ▫ Retention ▫ Bagacillo Addition ▫ Flocculant Addition ▫ Lime Addition ▫ Effects of Agitation ▫ Mud Withdrawal ▫ Filter Feed Mixing ▫ Temperature ▪ bagacillo system (from rotary juice screen and/or from final bagasse) ▪ filtrate receivers and pump ▪ vacuum pumps/ condenser ▪ mud filter (rotary drum filter or horizontal vacuum belt filter) Rotary Vacuum Filter ▫ Drum The major component of the rotary vacuum filter is a horizontal cylinder or drum. ▫ Boot The lower part of the drum dips down into the boot of the filter. ▫ Variable Speed Drive The drum is usually rotated by an electric variable speed motor or an adjustable ratio belt drive. ▫ Agitator	Individual pictures	Detailed diagrams/photos of Mud Filters equipment Condenser setup and volatiles How his type\ of condenser operates with little steam to condense to create required vacuum. Large flows of air through screens and mud need to be catered for. Similar but different to pan and effet condensers. A condenser and vacuum pump maintain the vacuum within the filtrate receivers. The condenser helps to generate the vacuum by condensing vapour from the hot filtrate. The vacuum pump contributes significantly to the vacuum because of the large proportion of air which is sucked through the cake along with the wash water. Volatile are gases produced and air passing through as the vacuum removes the water through the mud cake Materials including bagacillo from rotary screen filters or from bagacillo separator and services as required

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/ Diagrams	Course Outline
				The agitator is located in the boot of the filter. It maintains the conditioned primary mud or filter feed in a uniform state. The agitator does this by slowly moving back and forth through the mud in the boot to keep the mud mixed and so prevent the solid particles in the mud from settling out to the bottom of the boot. ▫ Filter Screens The surface of the filter drum is divided off into rectangles by a metal framework. Within each rectangular section of the drum, there is a perforated screen made from stainless steel. ▫ Drain Tubes Each of the closed cavities behind the perforated, outer surface of the drum is connected to a suction tube. Suction tubes remove the filtrate from the cavity behind the screen section. ▫ Rotary Valve Head The rotary valve head contains: o The trunnion or tube plate in which all filtrate drain pipes terminate. o A wear plate, which is a disc with drilled holes attached to the tube plate (the wear plate is normally made of a soft material with good wearing properties, bronze has been used traditionally but some factories use plastic). o The filter valve or port chamber. ▫ Wash Water Applicators Water sprays and dribblers are located at intervals around part of the circumference of the drum ▫ Contactor A contactor is a small mixing tank fitted with a slow speed stirrer. Flocculant is added here and the mixture stirred. ▫ Feed Pipe The feed pipe distributes the mud to several points along the boot. This, along with the action of the agitator ensures uniformity of the mud in the boot. ▫ Mud Scrapers the mud scraper consists of a series of short pivoted plates each having a soft tip which rubs over the surface of the screen Horizontal vacuum belt filters o Vacuum Belt Press Filters (VBPFs) o Horizontal cloth or belt filter using gravity then low-pressure vacuum then press pressure belt to extract filtrate from preconditioned mud. ▪ mud conveying system and storage The mud storage hopper or bin is an elevated steel structure which enables road vehicles to drive under the discharge door for loading. ▪ filter wash water supply ▪ lime, flocculant and filtrate recycle to mud system.		
1.3.3 See 1.3.1		Services used	Included in above list	Hot water, injection water, power and electrical circuits		
1.4.1	1.4 Select, fit and use personal protective	the purpose and limitations of protective	Additional hazards involved with the station	Hot water for drips and sprays. Hot pipes and surfaces. Rotating drum Moving cams and drives.	Pictures of the key elements with discussion,	PPE specific to Mud Filters On site safety resources eg First aid kit, eye wash, shower MSDS relevant to Mud Filters

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/ Diagrams	Course Outline
	equipment as required	clothing and equipment Select, fit and use personal protective clothing and/or equipment		Electrical circuits.	burns entanglement. .	
1.5.1	1.5 Set the mud filtration process to meet production requirements		equipment purpose and basic operating principles of mud filter equipment.	Throughput rate required and number of filters required to maximise through put and minimise pol loss in final mud	Screen shot of filters online and filters either in use or offline	Mud Filters capacity and throughput depending on number of filters operating and rotational speed Mud Filters station equipment Check DCS , lab reports, Shift logs and trends, Production Reports, Communication boards, shift supervisor and production managers recommendations
2 Operate and monitor Mud Filtration process *2.1.1*	2.1 Start and operate the mud filtration process according to operating procedures	Follow start up procedure confirm supply of necessary materials and services draw mud from the clarifier and assess mud quality	Auto or Manual Start up Sequencing	Startup SOP's, services used Power, cold water, hot water, The following procedures will need to be adapted to individual situations. Pre-start Checks = Visually check all mud conveyor belts and set up for a start (isolators on etc). = Check that the injection water valve to the filter condenser is turned on (fully open). = Check that the flocculant dispensers are clear and not blocked. = Check that the lime lines are clear and not blocked. = Close all the drain valves on the mud pumping system. = Shut the drain valves on the filter boots. = Shut the manual feed isolation valves into the boots. = Check that the manual pick-up and wash vacuum valves are shut. = Check that the manual spray water valves are shut. = Visually check filters for any problems or abnormalities. = Check the oil level in the filter lubricator and fill if necessary. = Position the scrapers against the screens. = Open the pick-up vacuum automatic valve. = Open the wash vacuum automatic valve. = Open the filter spray water automatic valve. Mud System Start Up = Open the manual isolation mud valves on the clarifiers. = Start the automatic mud withdrawal system. = Start the mud tank stirrer. = Commence lime saccharate addition. = Start the mud mixer. = Start the mud pump. = Check the mud mixer level controller and set to "auto". = Visually inspect the mud tank and the mud mixers. = Begin bagacillo addition.	Flow chart of startup 	Flow cart of startup both from boot empty and full Vacuum settings. (pick up vacuum 25 to 40 kPa, wash vacuum >70 kPa) the circuit flow of this process and relationship to related processes Separate filtrate connections are made to the pick-up (low vacuum) and washing/drying (high vacuum) ports from filtrate receivers. Isolation valves in each line are used to isolate or restrict flow during startup. During start-up, RVFs require manual intervention as the vacuum must be introduced steadily and carefully to the wash zones so that sufficient vacuum is available for the pick-up zone to establish and hold a cake on the screen.

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/ Diagrams	Course Outline
				= Start the filter vacuum pumps. = Turn on the sealing water to the pump. = Slowly open the main valve on the pump. = Turn on the sealing water to the filtrate pump. = Start the mud conveyor belts. Sequence start belts individually. = Turn on the mud belt interlocks once they are running. =Check that the filtrate receiver level is in "auto". =Check that the filter boot level is in "auto". = Check that the filter wash water flow is in "auto". = Check that the filtrate pump is in "auto". = Start the spray water pump. Filter Start Up = Observe that all progressive operations and outcomes of procedures are satisfactory. =Start the agitator. = Open the manual isolation valve to let mud down from the mud mixer to the filter boot. =Start the lubricator. = Start the filter drum at a slower than normal speed. = Once the filter boot is full of mud, slowly open the pick-up vacuum valve. = When the filter cake has almost reached the scrapers open the manual spray water valve a couple of turns. = Once sprays start, open the wash vacuum valve slowly, taking care not to allow the vacuum in the filtrate receiver to drop too low. = Open the spray water valve fully. = Commence and regulate flocculant addition. = Adjust the filter drive to the desired speed		
2.1.2		Start up and operate in both automatic and manual modes set up filters and start up the process	start up from empty or from full in manual and automatic modes	Startup SOP's, services used Power, cold water, hot water,	Start up and getting the initial mud cake to form on the screen from the vacuum produced and the mix of mud, juice, and bagacillo in the boot	requirement when starting up Mud Filters
2.1.3		Work is carried out in accordance with company policies and procedures, licensing requirements, manufacturer's recommendations, and legislative requirements, codes of practice	Check any related mill industry policies, awards, codes of practices that are specific to Mud Filters	Look for any key points	PowerPoint of relevant information	Industry related award and policy. SOP's

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/ Diagrams	Course Outline
		and industrial awards and agreements.				
2.2.1	2.2 Confirm process performance is maintained within specification	Monitor the process and equipment operation to maintain the process within the required parameters. This typically involves visual inspections and conducting tests to monitor characteristics such as: • throughput • clarifier mud levels and quality • filter speed and cake thickness • filtrate clarity and pH • mud pol and moisture • equipment condition including filter vacuum and scraper and screen condition • wash water flow and temperature	Set points, parameters, throughput, blocked screens, blinded screens, scrapers	Deviation outside of set point parameters and cause and recommended procedures for rectification Operate the Filter Station Complete automation of a filter stage is not feasible. One of the main things to be controlled is the mud level in the clarifier. Precise mud level control in clarifiers is not possible as mud levels are affected by many factors. The most important factor is the varying amount of solids in the incoming mud (the mud solids loading). The capacity in the mud zone of the clarifier is utilised to absorb short term fluctuations in mud levels. For longer term changes, the cake removal rate from the station is adjusted by manual alteration of one or a combination of the following variables: • Filter speed. • Bagacillo addition. • Flocculant addition. • Saccharate or lime addition. • Dilution of filter feed In addition to maintaining the mud level in the clarifier at normal working levels, the operator typically has to: • Maintain cake at the desired thickness. • Maintain minimum overflow from the filter boots. • Report major changes in mud levels, mud consistency i.e., fibre in cake, cake thickness, juice turbidity, pH. • Report any leaks, breakdowns, torn screens etc. • Maintain minimum filter revs needed to keep constant mud levels. • Use the maximum water rate that the cake will take -unless otherwise instructed. • Distribute water evenly with minimal running back into the filter boots. • Mix batches of flocculant as required. Record type and time on log sheets. • Take mud samples for laboratory analysis as required. • Take mud samples for weighing for tonnes output calculations. Record mud weights on log sheet. • Keep the station clean.	DCS photos, set point photos	DCS set points. High and low values. Control mechanisms. Visual checks that set point are being achieved. In sugar factories, the factor that limits filter operation is not the amount of mud to be handled or the cake drying process, but the cake washing. During cake washing, water is sprayed or dribbled onto the cake and sucked through by the vacuum. This is done to remove sugar which is in the mud. It is this washing process which typically takes the longest time in a complete revolution of the filter drum. The application of the water should not be such as to wash away the filter cake. Large amounts of wash water ultimately need to be removed by the evaporator so the load on it would be increased. This factor is of particular importance to factories with limited steam production capabilities.
2.2.2		Operating requirements and parameters the effect of variation in process parameters	Set points, parameters, throughput	Deviation outside of set point parameters and cause and recommended procedures for rectification	DCS photos, set point photos	Cake pol should ideally be below 1 per cent. Pol is a good but approximate measure of sugar (sucrose).
2.2.3		Significance and method of			DCS photos, set point photos	maintain required levels in the Mud Filters

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/ Diagrams	Course Outline
		monitoring control points within the process				
2.2.4		Control points refer to those key points in a work process that must be monitored and controlled.	Control points	Controls that the operator can and cannot change Wash water rate, mud scrapers, mud conditioning,	Photos of key control applications	significance and method of monitoring control points within the process
2.2.5		Material Safety Data Sheets (MSDS) where appropriate	Any chemicals used in cleaning, lubricants	SDS relevant titles only as data can change	MSDS	Material Safety Data Sheets where appro
2.3.1	2.3 Ensure mud meets specifications for pol and moisture	The effect of mud cake layer formation and porosity assess requirement for mud conditioning and add materials as required the purpose and role of materials added and their effect on filter operation the effect of mud age on filter performance	Schematic from SRI notes of mud layer formation on a screen	Conditioning of filter feed	Video and pictures of various mud qualities and thickness	High fibre levels, slimy, thin, thick, cracked, … and the effect on pol and moisture as these vary. Addition of flocculant, MOL or Saccharate Mud Conditioning ○ Retention Retention is defined as the mud solids retained in the filter cake, expressed as a percentage of total mud solids in the filter feed. That is, retention is what proportion of the mud solids fed to the filters is retained on the filters, scraped off and conveyed away to temporary storage. The other path the mud solids can take is to be sucked through the filter screen to end up in the filtrate which is recycled back through the clarifier. This recycle to the clarifier is undesirable because of the increased load it places on the clarifier. That is, high retention is good. ○ Bagacillo Addition Rotary vacuum filters require that the primary mud be mixed with a certain amount of bagacillo. Bagacillo is very fine particles of bagasse. The bagacillo helps form a porous mat that contributes to a better filtering medium and clearer filtrates. There are practical limits but increasing the addition of bagacillo will tend to increase retention. Bagacillo is obtained from two sources: • Any material passing through static or rotary juice screens with the juice and settled out in the clarifier with the mud. • Material separated from final mill bagasse using pneumatic separation and collection systems. ○ Flocculant Addition Additional flocculant is added to mud before filtering to reform the clumps of solid particles. Flocculant is normally added in the mud mixer toward the discharge end where there is adequate but gentle agitation or at a contactor. ○ Lime Addition By adding lime to mud, the pH is kept high so that the flocculant will work properly ○ Effects of Agitation Mud cannot be removed from the clarifiers and transported to the filter boot without being agitated. It is very difficult to decide on the exact amount of agitation, but it is generally accepted as good practise to minimise agitation. ○ Mud Withdrawal

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/ Diagrams	Course Outline
						Ideally, mud should be withdrawn continuously from the cone of the clarifier rather than intermittently. Continuous withdrawal should result in the primary mud having a more consistent quality. o Filter Feed Mixing Filter feed must be distributed evenly over the length of the filter. New feed must be mixed with existing material in the boot to avoid pockets of stale mud. o Temperature Viscosity is the property of a liquid that tends to prevent it from flowing when subjected to an applied force. High viscosity liquids resist flow. Low viscosity liquids flow easily. As temperature decreases, viscosity increases, and the rate of filtration consequently must also decrease. For this reason alone, it is important to minimise heat losses from primary mud and filter feed. Mud leaving the clarifier should be at or very near 100°C.
2.3.2		Control station throughput the effect of recycle streams on the mud filtration process	Scheduling, +4 hrs, +8hrs	Limiting factors for through put	Varys cane fields showing different soil types (SRA ?) Soil types; clay, red, sandy, loam, wet, flooded, dry	Schedule for current and forecast production rate relevant to supply. Mud up, high mud loadings, wet weather, variation in muds Just as the operation of the evaporator is affected by the operation of the filters (more wash water means more water to be removed by the evaporator), the operation of the clarifier is affected by the operation of the filters. Filtrates (the wash water after it has been sucked through the layer of mud on the drum) are recycled to a convenient vessel before the clarifier (normally either the primary or secondary mixed juice tank). Poorly performing filters can have a lot of mud in the filtrate. This imposes an additional load on the clarifier. The quality of the shipment sugar produced by the factory deteriorates when the clarifier is overloaded and mud solids may be carried over to the evaporator supply juice (ESJ).
2.3.3		• SUG202A Collect and prepare samples • SUG213A Perform standard tests on a cane sample • FDFOP2030A Operate a process control interface.	Need to look at what is relevant from these documents			Outside of scope
2.3.4		Production issues		common causes of variation and corrective action required	Vacuum, bagacillo addition, mud cake thickness and porosity, condenser and vacuum(air) pump, take off rate from clarifier	take corrective action in response to out-of-specification results
2.3.5		Factors that affect throughput		Mud loading, settling rate, floc formation, throughput, wet weather, cane farm soil, filtrate recycling, mud mixer, vacuum	Video of flocs settling in clarifier	Cleaning of screens
2.4.1	2.4 Monitor equipment to	Monitor the process and		Monitoring the Plant	Pictures of various mud	Mud filtration equipment may include: ▪ clarifier mud removal

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/ Diagrams	Course Outline
	confirm operating condition	equipment operation to maintain the process within the required parameters confirm equipment status and condition		Monitoring the plant is an important aspect of operating the filter station. Early detection of problems allows repairs to be planned and hence carried out in a more orderly and cost effective manner. A minor repair or adjustment when a problem is detected early can avoid a major and costly breakdown. The responsibility for monitoring the plant, reporting and rectifying any problems will vary significantly from factory to factory. Only general guidance is offered here. Normal practice at the factory should always be followed where this differs from the Study Notes. Stage inspections to monitor process and plant should be carried out on a regular basis. Equipment should be maintained in a safe and reliable condition. Any problems detected should be rectified and/or reported as appropriate. Monitoring of the plant on the filter station basically involves inspection of the actual plant and its operation and monitoring of instruments. Sensible safety procedures should be observed at all times when monitoring any item of plant. Guards should not be removed or by-passed to gain access. The possibility of injury due to rotating shafts and the like should be avoided. The operator should be aware of which items of plant can be started remotely or automatically. Close inspection of such equipment may require it to be isolated and tagged to avoid the possibility of injury. The temptation to "take a quick look" at such equipment without following normal safety procedures should be resisted. Some of the liquids on the filter station are hot enough to cause burns from leaks or by touching pipes	filters both drum and belt	▪ mud tank/mud mixer ▪ bagacillo system (from rotary juice screen and/or from final bagasse) ▪ filtrate receivers and pump ▪ vacuum pumps/ condenser ▪ mud filter (rotary drum filter or horizontal vacuum belt filter) ▪ mud conveying system and storage ▪ filter wash water supply ▪ lime, flocculant and filtrate recycle to mud system.
2.4.2	NOTE: See 2.1.3 covered here now and 2.1.3 removed	Manufacturer's specifications				Manufactures recommendations v's SOP's
2.4.3		Common causes of variation and corrective action required the effect of addition rates on the process	Doc with photos	Wash water application both sprays and dribblers Conveying System Faults • In factories where the discharge of the filter cake is by belt or screw conveyors, it is important to check components regularly. Belts wear and break or lose alignment. The rollers and motors can suffer serious defects that can be avoided with a preventative maintenance system and careful monitoring. This holds true for screw conveyors. Pol in Filter Cake too High If mud cake pol is high, the following are among the possible causes: • Vacuum incorrect. • Sprays ineffective. (Worn sprays are characterised by an abnormal spray pattern and should be replaced. Blocked sprays leave dry patches on the surface of the cake. Either condition should be rectified promptly.) • Cake thickness incorrect. • Bagacillo addition rate incorrect. (An excess of bagacillo produces thicker filter cake and therefore higher pol.) • Rate of wash water addition incorrect. (The amount of wash water affects the pol in filter cake. A typical target is		the risks and consequences of screen failure, bagacillo/mud ratio

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/ Diagrams	Course Outline
				150 per cent on filter cake. Smaller percentages of wash water result in higher pol. Higher percentages have little effect in reducing pol in filter cake but increase the load on the evaporator station.) Vacuum • Low vacuum should typically be 50 to 70 kPa and high vacuum should be 30 to 50 kPa. If either or both vacuums are too low, the system should be inspected for leaks, for injection water flow and temperature and the operation of the vacuum pump. If the problem is identified, factory procedures should be followed to get the repair made. • The appropriate supervisor or other personnel should be notified of the problem if the cause cannot be identified. If the low vacuum is defective, a cake will not form, or it will be too thin. If the high vacuum is defective, high pol and moisture of the cake will result. • Sometimes, due to wear in the valve seat, significant amounts of air can be sucked in through leaks at the valve. This reduces the vacuum. Cake Thickness The filter cake thickness should be checked periodically and corrected as often as necessary in order to maintain the thickness between the upper and lower limits specified at the particular factory. When the thickness of the cake is too thin, possible causes are: • Speed of rotation too fast. • Bagacillo level too low. • Defective vacuum (see above). These three parameters (filter speed, bagacillo addition and vacuum) can affect the capacity of the filter, bring about cloudy filtrates and risks of clogging. When the thickness of the cake is too great, high pol, greater sugar loss and high moisture of the cake are likely. Wash Water Strainers • An indication of a blocked strainer on the wash water line is a fall off in line pressure after the strainer or a drop on the wash water flow chart. Low water pressure may also result in uneven water distribution along the header pipes. All piping after the strainers should be of corrosion resistant material such as stainless steel to avoid corrosion products blocking the sprays. Filter Screens Screens can clog for the following reasons: • Mud too diluted. • Insufficient quantity of bagacillo. • Excess wax (mud contains wax from the cane plant, if the wax is melted by the wash water (see below), it can solidify in the holes through the screens and block them). • Excess dirt and sand for the capacity of the filter. • Insufficient wash water pressure.		

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/ Diagrams	Course Outline
				• Ineffective operation of scrapers. • Vacuum too low. • Ineffective scraper discharge, especially with thin cakes, causes screen blinding. If this is the result of momentary fall off in cake thickness, the blinded sections can sometimes be scraped manually (only if this is factory policy and it is safe to do so) until normal conditions are restored. However if the policy is to run thin cakes, the scraper design should be such as to cope with thin cakes. • Scraper geometry can be checked visually. The leading edge of the scrapers should rest evenly over the whole width of each screen and operate effectively with very little pressure applied to the screen. • As well as blinding of the small holes in the screens themselves, the cavity behind each screen can become blocked. It is essential to have thoroughly clean screens, backing grids and internal filtrate pipes. Blocked screens are indicated by bare patches on the filter when running with thin cakes. Blocked screens are more difficult to detect with thicker cake because the cake tends to bridge over the blocked section. • If screen blockage is detected early, it may be possible to clean the screens on the run with a water blast cleaner (only if this is factory procedure and it is safe to do so). If the screen has been blocked for some time, it might not be possible to clean the screen without prior treatment to soften the scale. • The procedure at some factories to treat blocked screens is to rotate the drums in warm caustic solution during planned maintenance stops. This is done using recirculation of the caustic "filtrate" to the boots through the normal filtrate piping and valve heads. The screens can then be cleaned with a water blast cleaner. Caustic is an aggressive cleaning chemical capable of causing chemical "burns". Factory procedures should be followed closely if chemical cleaning of filters is performed. • For long mill stops, usual factory practice is to empty the filter boots to avoid plugging of the backing grids and screens. • Some factories may apply steam to the screens just below the vacuum break during normal operation to try to keep the screens clear. Blocked Suction Tubes Any screen area not covered with mud could be an indication that the suction tubes or the screen are clogged. Operating filters with little or no wash tends to clog the screens and suction tubes. Instrumentation Defective With experience, an operator should be able to correlate station performance with the status indicated by the instrumentation. If the station is operating well and the instrumentation indicates		

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/ Diagrams	Course Outline
				otherwise, the instrumentation may be faulty. Depending on factory procedures, the relevant personnel should be contacted to check the instrumentation. Automatic Lubrication System Filters have an automatic, forced lubrication system. This equipment should be checked periodically to make sure that the proper level of oil is maintained and that all small tubes are dripping oil as they should be.		
2.4.4		Hazards and controls		Various hazards and controls Guards.	Photos of hazards/barriers to filters, covers on mud mixer	Detailed diagrams Interlocks On highly automated filter stations there is a system of interlocks which ensures that equipment is started and stopped in the correct sequence.
2.4.5		Operation and monitoring of equipment and processes typically requires the use of control panels and systems.	Doc with photos	DCS	Video of changes being made to a DCS	DCS changes and comparing to visual changes and lab results to see that changes are being achieved
2.5.1	2.5 Identify, rectify or report out-of-specification mud, process and equipment performance according to workplace procedures	Take corrective action in response to out-of-specification results	Doc and flow chart	Various out-of-spec process and performance described	Flow chart of what to do depending on the severity of the issue	the effect on mud pol, filtrate, condenser, mud solid retention Filtrate Recycling Filtrate from the filtrate pumps is returned to the mixed juice tank. Alternatively, it can be circulated back to the mud mixer to dilute the filter feed as required.
2.5.2		Report and/or record corrective action as required	The importance of the log and the records	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	Typical log entries	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification
2.5.3		Record workplace information	The importance of the log and the records	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	Typical log entries	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification
2.5.4		Environmental issues and controls	Refer to general site induction and policies	Mill policies, Regulations Solid wastes of any type should be carted away and not hosed into the drain system where they might cause a blockage or damage a pump. Liquid wastes and spills should be hosed into the appropriate drain. Usually factories have two systems of drains. Reclaim drains are used to recycle material back to process. Effluent drains remove waste liquid to the effluent system for further treatment.	Spills; flocculant/MOL/ saccharate/ Caustic(if used for cleaning screens)	Mill policies, Regulations for trenches/channels, spills
2.5.5		Waste handling requirements and procedures	Refer to general site induction and policies	Mill policies, Regulations	Video of techniques used	Mill policies, Regulations for trenches/channels, spills as related to Mud Filters
2.5.6		Lock out and tag out procedures	Refer to general site induction and policies	Mill policies, Regulations	Flow diagram and pictures of tags and locks	Mill policies, Regulations for trenches/channels, spills as related to Mud Filters

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/ Diagrams	Course Outline
2.6.1	2.6 The workplace meets housekeeping standards (nota FBP criteria)	Housekeeping standards and procedures	Control area or room,	Neat, tidy, stocked with required equipment, no clutter from personal items from shift to shift	Pictures of the good the bad and the ugly	Control room and general set up and organisation
2.6.2		Maintain work area to meet housekeeping standards	Control area or room,	Neat, tidy, stocked with required equipment, no clutter from personal items from shift to shift Individual factories will have their own cleaning schedules and cleaning requirements. Cleaning may be divided into non-routine cleaning (done as required) and routine cleaning. Non-routine Cleaning Non-routine cleaning tasks include cleaning up mud or filtrate spills. Product spills should be cleaned up promptly. The sugar concentration and warm temperature at the filter stage will cause bacteria to multiply. Bacterial contamination causes slime to form which can render floors dangerously slippery. Routine Cleaning Routine cleaning includes: Keeping the console room tidy and sweeping and mopping the floor every shift. Cleaning the screens on the sealing water supply to the vacuum pumps as required. Cleaning filter screens. Maintaining scrapers. Maintaining the wash water system.	Pictures of the good the bad and the ugly	Control room and general set up and organisation
2.6.3		Confirming that housekeeping standards are met	Control area or room	Neat, tidy, stocked with required equipment, no clutter from personal items from shift to shift	Pictures of the good the bad and the ugly	Control room and general set up and organisation
3 3 Handover the Mud Filtration process *3.1.1*	3.1 Maintain workplace records according to workplace requirements	Record workplace information	Doc explaining the importance of changeover log	Time, what happened in lead up to issue, issue, who contacted, follow up, current situation, further monitoring. Legibility, clear concise information	Log books written and electronic	Recording of information during shift. Time, what happened in lead up to issue, issue, who contacted, follow up, current situation, further monitoring. Legibility, clear concise information
3.1.2		Recording requirements and procedures	Doc explaining the importance of changeover log	Time, what happened in lead up to issue, issue, who contacted, follow up, current situation, further monitoring	Pictures or power points of operator/shift supervisor/electrician etc discussing an issue and log book data recording	Recording of information during shift, Time, what happened in lead up to issue, issue, who contacted, follow up, current situation, further monitoring. Legibility, clear concise information
3.2.1	3.2 Carry out shift changeover according to workplace procedures	Record workplace information	Mill logs, verbal communication	Importance of standard procedure on delivery of information at change over via log books, verbally and visually	Mill commonly used procedure in a flow chart	Hand over, what is expected, details, verbal and written communication, scheduling for next 4 to 8 hrs that may impact on throughput

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/ Diagrams	Course Outline
3.2.2		Recording requirements and procedures	Mill logs, verbal communication	Importance of standard procedure on delivery of information at change over via log books, verbally and visually	Mill commonly used procedure in a flow chart	DCS displays and trends during shift
3.3.1	3.3 Ensure mud filtration station operators are aware of system and related equipment status at completion of handover	Record workplace information	Questioning and understanding that handover information has been transmitted and received	Checking by both the person finishing a shift and the new operator that both are satisfied that all relevant information has been given and understood	Video of discussion at handover showing both log book and issue	Questioning by new operator of written and verbal instructions to check complete understanding of all instructions
3.3.2		Recording requirements and procedures	Questioning and understanding that handover information has been transmitted and received	Checking by both the person finishing a shift and the new operator that both are satisfied that all relevant information has been given and understood	Video of discussion at handover showing both log book and issue	Questioning by new operator of written and verbal instructions to check complete understanding of all instructions
4. Shut down the mud filtration process *4.1.1*	4.1 Identify the appropriate shutdown procedure for operational and long-term shutdown conditions	The circuit flow of this process and relationship to related processes	Flow diagram and why order of shut down is important. Auto and manual	Order of shut down DCS and visual inspections Shutdown Procedure = Crushing ceases. =Redirect filtrate to the clarifier. = The juice level in clarifier will be lowered to a level that is known to allow the clarifier to accept the filtrate that goes to the mixed juice tank during normal operations. = Once this level has been achieved, stop lime, bagacillo and flocculant addition. = Flush flocculant lines with water. = Close the mud valve from the clarifier. = When the mud tank is empty, stop the stirrer and mud pump. = Open mud tank drain to effluent. = When mud mixer is empty, close filter feed valve. = Observe cake, turn off wash water when cake thins. = Open drain on mud mixer to effluent. = Continue filter operation until cake pick-up ceases. = Turn off the filtrate pump. = Turn off the vacuum pump. = Turn off the sealing water. = Turn off the injection water to the condenser. = Turn off the drum drive. = Drain the filter boot and hose out all sand. = Turn off the agitator. = Take scrapers off the screens. = Hose out all tanks. = Turn off belts in appropriate order. =Hose off all belts. = Visually check and report any plant that may need	Mud Filters, mud mixer, condenser, bagacillo separator, mud belt, mud tank	shut down sequence requirements of both operational and long term shut down conditions to ensure the equipment is left in a safe state for the period of the shutdown and to minimise any delays in future start up

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/ Diagrams	Course Outline
4.1.2 (see 4.1.1)		Requirements when shutting down full Mud Filters				requirements when shutting down full Mud Filters
4.1.3		Shut down equipment in response to an emergency situation	Types of emergencies and where and what operator can do	Life, fire, overfilling, hot water Emergency Shutdown In the event of an emergency shutdown each factory will have its own recommended procedure. However, because "emergencies" are likely to be different by their very nature, there can be no fern procedure to follow. Generally, the response to an emergency situation will require operation of stop buttons and isolation valves in the "best" order as dictated by the situation. As a general rule, the ordering of priorities in an emergency is: People. (The first emergency actions should avoid or minimise risk of injury or potential injury to personnel. Emergency actions should not make a situation unacceptably dangerous to any workers of the workplace.) Equipment. (Once possible risks to people has been brought under control, actions that will avoid or minimise damage to equipment should be performed.) Product. (Once risks to people and damage of equipment has been avoided or minimised, emergency actions should concentrate on avoiding/minimising product loss and difficulties on the subsequent re-start.) Emergency situations on the filter station could arise due to events such as: Leaks from pipes carrying hot fluids. Faults in the vacuum system. Damage to the boot agitator. Breakdown of conveyor belts. Tearing of the filter screens by the scrapers. Modern filter stations are generally well automated but monitoring is necessary to ensure that the control system is operating effectively. For example, when running in "auto", the operator should not take for granted the operation of valves. After opening a feed valve, it would be good practice to verify operation of the valve either visually or by witnessing the appropriate reaction e.g., an increase in receiver tank level.	Stop options available depending on the situation	shut down equipment in response to an emergency situation
4.2.1	4.2 Safely shut down the mud filtration system according to operating procedures	Shut down and clean Mud Filters according to schedule or as indicated by equipment monitoring	Doc + Photos		Pictures of various pumps and reheaters	SOP's of shut down and visual inspections of proceedings
4.2.2		Shut down and clean Mud Filters according to schedule or as indicated by	Procedures, inspections, communication		pictures of cleaning Mud Filters. High pressure hosing, chemical clean	SOP's of shut down and visual inspections of proceedings

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/ Diagrams	Course Outline
		equipment monitoring				
4.3.1	4.3 Safely shut down the mud filtration system according to operating procedures	requirements of both operational and long term shut down conditions to ensure the equipment is left in a safe state for the period of the shutdown and to minimise any delays in future start up	Doc + Photos	Checks required prior to maintenance season schedule	Shut down and storage Mud Filters	Shut down and storage Mud Filters
4.4.1	4.4 Identify and report operational maintenance requirements according to workplace procedures	procedures and responsibility for reporting problems	Importance of the log and the records	Issues and maintenance program identified in consultation with appropriate staff from seasons log book issues and schedules		Checks of all equipment and documentation of required maintenance

12.4 Appendix 4 - Operate an evaporation process content matrix

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
Overview of Evaporation operations *0.1*	Overview of Evaporation operations	The circuit flow of this process and relationship to related processes terminology relating to evaporator process	Evaporation operation station overview. Written description with photos. Video/presentation of the sugar process and where the Evaporation operations sit. Flow Chart	Terminology. What an operator can influence. What the Evaporation operations station is trying to achieve How a very good evaporation process station and operator will function. PPE specific to the Evaporation operation	Flow chart of inputs output, machinery, in an ideal set up.	Aim of the Evaporation operation The aim of the evaporator is to produce a syrup of specified brix. The density (brix) of incoming juice determines how much water must be removed by the effets to produce syrup of the required brix. An ESJ with a low brix will contain relatively more water and so require a greater amount of evaporation and influence the operations of the evaporator. The syrup leaving the final effet must be within a certain range of brix. A brix controller is connected to the final vessel. This controller operates a valve to ensure that the syrup which goes to the pan stage has the required brix. A constant flow of syrup is pumped to a brix sampler which provides information for the brix controller. The sample flow is normally recirculated back to the juice inlet of the final vessel. Low ESJ brix effectively reduces the rate at which syrup is produced because more water must be evaporated before the ESJ is changed into syrup of the required brix. The purpose of the effet stage is to remove as much water from the juice as possible in a manner which is economical in the usage of process steam. This will then minimise the amount of "work" to be done by the pan stage to crystallise the sugar and leave as much LP (exhaust) steam as possible for use by other stations. Parameters an operator can and cannot influence Parameters and set points why upper and lower limits Glossary terms SOP's	
0.2 terminology	*terminology*			Glossary		Brix: The measurement in percentage by weight of sucrose in pure water solution. Syrup (or Liquor) ESJ Vapor Condense Condensate Noxious gas Injection water Vapor bleeds Heat transfer or HTC Vacuum: Vacuum is simply a pressure below atmospheric pressure. It is important to understand that high vacuum is a low absolute pressure (close to OkPa or -101.3kPag) and that a low vacuum is a higher absolute pressure but still below atmospheric pressure, say 91.3kPa or -10kPag. Pressure kPa.: standard atmospheric pressure (or 1 atm) is defined as 101.325 kPa. Gauge Pressure: The gauge pressure of the air around us is 0kPag	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
						Boiling Temperature and Pressure: The higher the vacuum then the lower boiling temperature	
Overview of Evaporation equipment *0.3*	basic operating principles of evaporation equipment, including: main equipment components	equipment purpose and basic operating principles of evaporator equipment	List with photos	Evaporation operation capacity and residence time Evaporation operation station equipment Evaporation equipment may include: ▪ ESJ tank ▪ Pre and quin or quad effets ▪ Vapour bleeds ▪ Injection pump ▪ vapour condensers and vacuum pump ▪ DCS and circuits ▪ Liquor or syrup tank	Photos or diagram of Evaporator station A single evaporator vessel (Figure 2.1) is a large, closed vessel designed to boil liquids under a range of pressures varying from 10 to 140kPa. The height of the vessel is much greater than the width. This helps to reduce the carryover of droplets into the vapour boiled off in the vessel. The heating surface of an effet is called the calandria. The calandria occupies the lower section of the vessel and consists of a totally enclosed area bounded by the top and bottom tube plates. A series of tubes (normally stainless steel) pass through the calandria and allow the juice to pass from the bottom section of the vessel to the top. Steam entering the calandria does not come into contact with the juice. The heat given off by the steam as it condenses on the relatively cooler surface of the tube, is transferred through the tube to the juice. The temperature difference between steam and juice is the driving force of heat transfer. This is the reason that the highest number of effets in a set is usually five (a quintuple set). After the fifth vessel, the temperature difference between the steam and the syrup would not be very large and so the heat transfer would be small. Feed enters at the bottom of the vessel and must be evenly distributed using some type of distribution device (Item 13 in Figure 2.1). The juice rises up the tubes and down again, being heated in the process. Sometimes a number of larger diameter tubes, called down-comers, are installed as well. These assist juice circulation. The juice is removed from the bottom of the vessel.	The following example, used to illustrate the syrup production process in a quadruple set, gives typical operating conditions only. Nonetheless, it allows one to get some feel for the conditions which exist throughout a set. Each effet stage will have a different configuration and operating parameters will vary from factory to factory. ESJ is pumped into the first vessel which is under a pressure of around 140 kilopascals (kPa). The brix of ESJ varies from 14 to 17. Steam enters the calandria at a pressure of around 200kPa and a temperature of 120°C. The vapour temperature in the first vessel is 110 °C. The juice exiting the first vessel and entering the second vessel has a brix of 20 to 23. The second vessel is at atmospheric pressure (about 100kPa) and the vapour has a temperature of 100 °C. The juice brix exiting the second vessel and entering the third vessel is between 25 and 30 brix. The absolute pressure (actually a partial vacuum as the absolute pressure is below atmospheric pressure) of the vessel is around 60kPa and the vapour temperature is about 80 °C. Juice leaves the third effet at 35 to 40 brix. The final vessel has a pressure of 10 kPa and a vapour temperature of 60 °C. Syrup exiting the vessel has a brix range of 60 to 70 and is pumped to the syrup tank on the pan stage.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
					The vapour that comes off the boiling juice is transferred through a large diameter vapour pipe to the calandria of the next vessel A device called an entrainment separator is fitted in the vapour path near the top of the vessel. This device traps the small droplets of juice in the vapour that leaves one effet and passes to the calandria of the next or that passes from the final effet to the condenser. Due to the rapid boiling in the effet, juice is expelled upwards from the top of the tubes with great velocity and droplets of juice can travel to quite a height. The velocity of the juice leaving the tubes increases from the first to the last vessel as the vacuum becomes higher. The height that the juice is projected upwards is also much greater. Therefore entrainment is most serious in the final vessel. The final vessel, at least, requires some sort of entrainment separation device. The vapour from the final vessel passes to a condenser where the vapours are condensed and vacuum maintained. The condenser is a closed vessel connected to a long pipe called a Torricellian leg which terminates in a water well. Atmospheric pressure can support a column of water about 10 metres high and this is the approximate length of the Torricellian leg. The vapours are mixed with water and condense. Incondensable gases are removed from the system by a vacuum pump. An injection water pump is required to supply the cooling water to the condenser.		

<table>
<tr><th>Element / (code)</th><th>Performance Criteria</th><th>Required knowledge</th><th>Requirements for LMS</th><th>Key points</th><th>Photos/Videos/Diagrams</th><th>Course Outline</th><th>Content and quiz</th></tr>
<tr>
<td>Overview of steam usage and the relationship between boiling point and pressure as applied to evaporation 0.4</td>
<td>an understanding of the principles of steam

Pressure, measuring, scale, positive – negative, boiling point, reuse of vapor from each vessel after #1

the changes that occur to product as it moves through the evaporation process</td>
<td></td>
<td></td>
<td><table>
<tr><th>Parameter</th><th colspan="4">Vessel Number</th></tr>
<tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>Brix in</td><td>16.0</td><td>21.1</td><td>27.1</td><td>38.4</td></tr>
<tr><td>Brix out[b]</td><td>21.1</td><td>27.1</td><td>38.4</td><td>70.0</td></tr>
<tr><td>Residence time (min)[c,d]</td><td>3.2</td><td>4.2</td><td>5.6</td><td>8.8</td></tr>
<tr><td>Inlet juice temperature, (˚C)</td><td>96.0</td><td>108.3</td><td>100.0</td><td>88.6</td></tr>
<tr><td>Outlet juice temperature, (˚C)</td><td>108.3</td><td>100.0</td><td>88.6</td><td>56.3</td></tr>
<tr><td>BP elevation (˚C)[e]</td><td>0.5</td><td>0.7</td><td>1.2</td><td>4.3</td></tr>
<tr><td>Juice flow in (t/h)</td><td>423</td><td>321</td><td>250</td><td>176</td></tr>
<tr><td>Juice flow out (t/h)</td><td>321</td><td>250</td><td>176</td><td>97</td></tr>
</table></td>
<td>The vacuum in the last effect is produced by condensing the vapour in a barometric condenser. By regulating the injection water supply to the condenser, the final vacuum can be controlled. Increasing the flow of injection water will raise the vacuum (lower the absolute pressure). Decreasing the flow of injection water will tend to reduce the vacuum (raise the absolute pressure). Typically, the injection water flow is controlled by measuring the vacuum and adjusting the flow of injection water appropriately
Table 3.1 Parameters Operating in a Quadruple Evaporator
Systema of a Typical Industry Factory
A Crushing rate of about 400 tch (tonnes of cane per hour).
B Approximate operating brix.
C Calculated on average juice flow rate i.e. average of flow in and flow out.
D Total time 21.8 min.
E Increase in boiling point due to brix. Figure included in outlet temperature.
Vacuum
The temperature at which juice boils depends on the pressure of the juice. The higher the pressure, the hotter the juice will have to be before the gas bubbles, which define boiling, will form. Consequently, a change in the vacuum of the final vessel will cause a corresponding change in the boiling temperature and this will affect the operation of the evaporator set.
In a multiple effet set, usually only the pressure of the vapour from the final vessel is controlled. This is controlled through the operation of the condenser. The other pressures and associated temperatures through the set are not controlled. They settle down at values depending on the amount of heat transferred and the conditions present in each vessel.
Steady operation of the evaporator set will be more likely if the vacuum on the final effect can be controlled to a constant value. Thus, while vacuum</td>
<td>Pressure and Vacuum. Before describing the operation of the evaporator, it is necessary to have a good understanding of pressure and vacuum. Pressure is an applied force distributed over some area. The definition of absolute pressure is the magnitude of the applied force divided by the area over which the force is applied. The word "absolute" is often omitted and it is just called pressure.
Pressure is measured in kilopascals (kPa). Atmospheric pressure is 101.3kPa at sea level and it decreases with increasing altitude. Vacuum is simply a pressure below atmospheric pressure. An absolute pressure of 0 kPa would correspond to a perfect vacuum.
Pressure is sometimes expressed relative to atmospheric pressure. It is then called "gauge pressure". The units of gauge pressure are kilopascals (gauge) which are abbreviated to kPag. This is to distinguish gauge pressure from absolute pressure which is written with units of just kilopascals (kPa).
The gauge pressure of the air around us is 0kPag because gauge pressure is measured relative to atmospheric pressure. A perfect vacuum is a gauge pressure of -101.3kPag.
There can be different degrees of vacuum. In order to avoid confusion during communication on and about the effet station, it is important to understand that high vacuum is a low absolute pressure (close to OkPa or -101.3kPag) and that a low vacuum is a higher absolute pressure but still below atmospheric pressure, say 91.3kPa or -10kPag.</td>
<td></td>
</tr>
</table>

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
					does influence the operation of the evaporator set, it is normal to try to control vacuum to a constant value so that it does not influence the operation of the set.		
1. Prepare for work in processing area *1.1.1*	1.1 Read or listen to work instructions from supervisor and clarify where needed accessing workplace information to identify processing requirements	Conducting relevant pre-start checks with operational personal Current operating throughput, schedule, limiting factors. DCS what it is, does and how it relates to the physical equipment	Confirm equipment status and condition Visual and DCS checks	What to look for. Checking of prior entries to log book	Operator on two way/m ph DCS showing availability of cold water, hot water, and power	What is the time between pan drop and entering Evaporation operation	
1.1.2		Recording requirements and procedures	Doc explaining the importance of changeover log	Time, what happened in lead up to issue, issue, who contacted, follow up, current situation, further monitoring	Pictures or power points of operator/shift supervisor/electrician etc discussing an issue and log book data recording	Recording of information during shift, Time, what happened in lead up to issue, issue, who contacted, follow up, current situation, further monitoring. Legibility, clear concise information	
1.1.3	The work area is maintained according to housekeeping standards	Housekeeping standards and procedures	Control area or room,	Neat, tidy, stocked with required equipment, no clutter from personal items from shift to shift	Pictures of the good the bad and the ugly	Control room and general set up and organisation	
1.1.4		Maintain work area to meet housekeeping standards	Control area or room,	Neat, tidy, stocked with required equipment, no clutter from personal items from shift to shift	Pictures of the good the bad and the ugly	Control room and general set up and organisation	
1.1.5		Confirming that housekeeping standards are met	Control area or room	Neat, tidy, stocked with required equipment, no clutter from personal items from shift to shift	Pictures of the good the bad and the ugly	Control room and general set up and organisation	
1.1.6	Work is conducted according to workplace environmental standards						
1.1.7	Workplace records are maintained according to workplace recording requirements						

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
1.2.1	1.2 Confirm materials are available to meet operating and food safety requirements confirming supply of necessary materials and services	ESJ supply, Brix Steam, water(injection), power,	Confirm supply of necessary materials and services	Checks required prior to filling of Evaporation operations Visual and DCS checks SOP Communication with pan operator and Shift supervisor	Uniform juice feed is essential for smooth operation of the evaporator set especially when vapour bleeding is practised. The feed supply is kept uniform by using the ESJ tank for surge control.	If the clarification stage is not performing as it should, the ESJ will contain suspended solids and appear cloudy. These solids will carry through the evaporator to the syrup supplied to the pan stage. The presence of the solids in the syrup will reduce the quality of the sugar which can be crystallised by the pans and separated by the fugals. Steam Flow The rate of operation of the effet set is determined by the LP or exhaust steam supplied to the first vessel. The temperature in the calandria of the first effet is determined by the pressure of the exhaust steam available which in turn depends on the factory steam cycle and power generation needs. Smooth operation of the set requires a steady steam pressure. Unless other parts of the factory are having difficulties, the evaporator can normally expect a supply of steam at a steady pressure. Vacuum The temperature at which juice boils depends on the pressure of the juice. The higher the pressure, the hotter the juice will have to be before the gas bubbles, which define boiling, will form. Consequently, a change in the vacuum of the final vessel will cause a corresponding change in the boiling temperature and this will affect the operation of the evaporator set. In a multiple effet set, usually only the pressure of the vapour from the final vessel is controlled. This is controlled through the operation of the condenser. The other pressures and associated temperatures through the set are not controlled. They settle down at values depending on the amount of heat transferred and the conditions present in each vessel. Steady operation of the evaporator set will be more likely if the vacuum on the final effect can be controlled to a constant value. Thus, while vacuum does influence the operation of the evaporator set, it is normal to try to control vacuum to a constant value so that it does not influence the operation of the set. Juice Flow Uniform juice feed is essential for smooth operation of the evaporator set especially when vapour bleeding is practised. The feed supply is kept uniform by using the ESJ tank for surge control.	
1.3.1	1.3 Identify and confirm cleaning and maintenance	Conducting relevant pre-start checks all safe guards are in place	Confirm equipment status and condition Visual and DCS checks	What to look for. Checking of prior entries to log book		Scaling, effets performance, see evaporator cleaning module for full details.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
	requirements and status cleaning and sanitising equipment according to workplace procedures	equipment is operational					
1.4.1	1.4 Wear appropriate personal protective clothing and ensure correct fit according to work health and safety requirements selecting, fitting and using personal protective clothing and/or equipment	Purpose and limitations of protective clothing	Additional hazards involved with the station	Hot water for cleaning. Hot pipes and surfaces. Hot ESJ Steam. Electrical circuits.	Pictures of the key elements with discussion, burns .	PPE specific to Evaporation operations On site safety resources eg First aid kit, eye wash, shower MSDS relevant to Evaporation operations	
	isolation, lock-out and tag-out procedures and responsibilities	Lock out and tag out procedures	Refer to general site induction and policies	Mill policies, Regulations	Flow diagram and pictures of tags and locks	Mill policies, Regulations for Ponds, cooling towers, trenches/channels, spills as related to Evaporation operations	
2. Prepare the evaporation process for operation *2.1.1*	2.1 Enter processing and operating parameters as required to meet safety and production requirements basic operating principles of process control, including the relationship	Operation and monitoring of equipment and processes typically requires the use of control panels and systems. using process control systems according to workplace procedures	Doc with photos	DCS	Video of changes being made to a DCS The target pH for syrup is 6.5. This is the optimum pH for the crystallisation process. Syrup close to this pH gives: & Massecuites which are easiest to boil. Minimum development of undesirable compounds and colour. & Little loss of sucrose by inversion. Vapour Bleeding Where vapour bleeding is carried out (normally for juice heating or to boil the pans), then it is important that the pressure of that vapour not be allowed to fall below a prescribed limit. If the vapour bleed becomes too low in	DCS changes and comparing to visual changes and lab results to see that changes are being achieved The instrumentation on the effet station should be well known Operation of an evaporator set requires control of: ESJ tank level. Steam supply to the first effet. Pressure of pre-evaporator or first vapour. Juice level in the pots. Brix of the syrup produced. Vacuum on the last effect.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
	between control panels and systems and the physical equipment				pressure, the other stations using the vapour will experience difficulties. Changes in vapour bleeding arrangements will obviously affect the operation of the evaporator. Basically, the more vapour that is bled, the more steam that must be supplied to the set to compensate.		
2.1.2	operating requirements and parameters and corrective action required where operation is outside specified operating parameters	Operating requirements and parameters	Set points, parameters, throughput	Deviation outside of set point parameters and cause and recommended procedures for rectification	DCS photos, set point photos ESJ tank and then Evaporation operation	DCS set points. High and low values. Control mechanisms. Visual checks that set point are being achieved.	
2.1.3	inspection or test points (control points) in the process and the related procedures and recording requirements the purpose and location of sensors and related feedback instrumentati on	Significance and method of monitoring control points within the process	Control points v's set points		DCS photos, set point photos	maintain required levels in the Evaporation operations	
2.1.4		Control points refer to those key points in a work process that must be monitored and controlled.	Control points v's set points	Controls that the operator can and cannot change	Photos of key control applications	significance and method of monitoring control points within the process Brix throughout evaporators and final brix of liquor/syrup	
2.1.5	contamination /food safety risks associated with the process and related control					If there is sugar in the vapour coming from the final effect, the sugar will be lost in the condenser water where it will cause pollution. Constant monitoring of condensates for contamination by sugar is extremely important.	

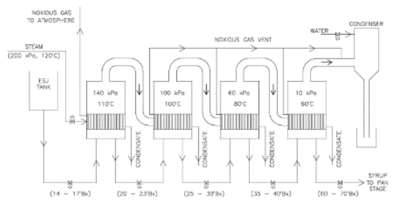
Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
	measures relevant to the evaporation process						
2.1.6	the flow of the evaporation process and the effect of product output on downstream processes				Enzyme Addition When commercial amylase is added at the evaporator to increase starch removal, the enzyme is usually added to the third vessel of a quadruple set (Figure 2.2). This is to ensure that the temperature is not too high for the enzyme which can lose its effectiveness if exposed to higher temperatures.		
2.1.7	work health and safety hazards and controls relevant to the evaporation process following relevant work health and safety procedures.	Material Safety Data Sheets(MSDS) where appropriate (see Evaporator cleaning course E04)	Any chemicals used in cleaning	SDS relevant titles only as data can change	MSDS photo with relevant title but blurred information	Material Safety Data Sheets where appropriate Caustic, EDTA	
2.1.8	Work is carried out in accordance with company policies and procedures, licensing requirements, manufacturer's recommendations, and legislative requirements, codes of practice and industrial awards and agreements.		Check any related mill industry policies, awards, codes of practices that are specific to Evaporation operations	Look for any key points	PowerPoint of relevant information	Industry related award and policy. SOP's	
2.2.1	2.2 Check equipment performance and adjust	Monitor the process and equipment operation to	Set points, parameters, throughput	Deviation outside of set point parameters and cause and recommended procedures for rectification	DCS photos, set point photos	ESJ quality and quantity available Pre checks visual, DCS, Safe guards in place, communication with pans/Shift supervisor and	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
	according to operating requirements quality characteristics to be achieved by the evaporation process	maintain the process within the required parameters (Brix)				other operators. Checking of shift log Walk past all equipment at start of shift/ start up Handover at start of shift	
2.3.1	2.3 Carry out pre-start checks according to operator instructions status and purpose of guards equipment operating capacities and applications preparing materials for an evaporation process quality requirements of materials and the effect of variation on process performance	conducting pre-start checks, including: inspecting equipment condition to identify any signs of wear selecting appropriate settings and/or related parameters cancelling isolation or lock-outs as required confirming that equipment is clean and correctly configured for processing requirements positioning sensors and controls correctly ensuring any scheduled maintenance has been carried out confirming that all safety guards are in place and operational				Preparation Inspect the inside of vessels to ensure that no foreign articles such as tools or rags have been inadvertently left inside. Close access doors on all vessels: = Top access door. = Evaporator body access door. = Bottom access door. Check that the following valves on all vessels are closed: = Water service valve. = Drain valve. = Caustic valve. = Juice line isolating valves. = Noxious gas vents. Check that the vapour bleeding valve is closed. Add a small amount of water or juice to each vessel (sufficient to cover the lower tube plate of the calandria). Note the level in the gauge glass. Check the oil level in the vacuum pump. Close the inlet valve to the vacuum pump. Open the inlet valve and close the discharge valve of the ESJ pump.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
3. Operate and monitor the evaporation process *3.1.1*	3.1 Start, operate and monitor the process for variation in operating conditions according to work health and safety and operating requirements	Start up and operate in both automatic and manual modes starting, operating, monitoring and adjusting evaporation equipment to achieve required outcomes, including monitoring control points and conducting inspections as required to confirm process remains within specification, including: temperatures vacuum motor amperage condensate flow steam flow and pressure throughput time/speed evaporated product characteristics	start up from empty or from full in manual and automatic modes	Startup SOP's, services used Power, cold water, hot water,		requirement when starting up full Evaporation operations The liquid water from the condensing steam or vapour is called condensate and must be removed as rapidly as it forms. Start Up to Manual Idle Condition Partly open the injection water valve. Start the injection water pump. Observe the water flowing from the Torricellian well, and that the vacuum in the final vessel commences to increase, due to the water flowing through the condenser. Start the vacuum pump, and slowly open its inlet valve. Observe the vacuum continuing to increase. Partly open the noxious gas vents on all vessels. Partly open the steam valve to the first vessel, and check that the pressure gauge indicates an increase in calandria pressure. Start the first vessel calandria condensate pump, if fitted. Otherwise open the valve to the boiler feed water tank. Observe the calandria gauge glass to ensure condensate is draining. Observe the water in the first vessel as it heats up and commences boiling. Add water to maintain the initial static level in the first vessel. Special small by-pass valves are sometimes fitted for this purpose. If there is a throttling valve in the vapour pipe to the second vessel, open it wide. When the vapour pipe to the second vessel begins to warm up, start the second vessel condensate pump . Observe the water in the second vessel as it heats up and commences to boil. Add water to maintain the initial static level. Proceed as above for subsequent effects along the set. When the vapour pipe to the final vessel begins to warm up, start the final vessel condensate pump. If the set is equipped with vacuum control, fully open the water supply valve and allow the vacuum controller to take over. Adjust water addition valves to maintain steady static levels for the idle condition.	
3.1.2		Follow start up procedure	Auto or Manual Start up Sequencing	Startup SOP's, services used Power, cold water (injection), hot water, steam	Flow chart of startup	Flow cart of startup both empty and full the circuit flow of this process and relationship to related processes Start Up When juice enters the ESJ tank: Start the ESJ pump and slowly open its discharge valve. Open the juice isolation valve to the first vessel, and shut the water addition valve. Fully open the steam valve to the first vessel. Observe that the automatic level controller, and the steam controller take over. This may require switching the level controller from manual to automatic. Open the juice isolation valve to the second vessel, and shut the water addition valve.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
						When the automatic level controller takes over, open the juice isolation valve to the third vessel, and shut the water addition valve. This may require switching the level controller from manual to automatic. Working toward the final effect, repeat this procedure for each effect along the set. Adjust all noxious gas valves to the usual settings. Open the vapour bleed valves to enable bleeding to heaters etc. Adjust the throttling vapour valve in the vapour pipe to the second vessel. Start the syrup pump and commence recirculating the liquid in the final vessel. Observe the liquid splashing on the sight glasses of the vessels. Make frequent observations of pressure gauges and level gauges during start up. When the liquid in the final vessel begins to concentrate, start the brix sampler. Observe the brix rise to the set point and advise the pan stage operator of the impending delivery of fresh syrup. Observe that syrup delivery occurs, and that the evaporator station is functioning satisfactorily	
3.2.1	3.2 Identify variation in equipment operation and report maintenance requirements	The effect of Brix control throughout the effets and its effect on overall through put. Scaling in different effets and its effect on heat transfer.	Scales chart	Effect of impurities on heat transfer and brix.	Video and pictures of various effets and brix.	Evaporator scaling or fouling is the formation of deposits on the juice side of the tubes due to the heat transfer. These deposits are composed of various inorganic materials, called ash or impurities, present in the ESJ. The amount and type of scale depends mainly on the composition of the juice itself. The impurities are initially dissolved in the ESJ when it enters the evaporator. As the juice becomes more and more concentrated on its passage through the evaporator, there is not enough water present to keep the impurities in solution and so they deposit as a thin layer of solid material on the inside walls of the calandria tubes. Scale deposits slow the transfer of heat from the steam across the wall thickness of the tube and through the scale deposit to the juice. Scale also causes resistance to juice flow. Both of these factors reduce heat transfer and affect steam consumption due to inefficient operation of the set. The scale does not usually deposit uniformly along the tube. Deposition is typically worst at the bottom of the tube where circulation of the juice is slower. At most factories, scaling is worse in the final vessels.	
3.2.2	typical equipment faults and related causes, including signs and symptoms of faulty equipment and early	Control station throughput	Scheduling, +4 hrs, +8hrs	C- massecuite production rates from batch and continuous pans	Scale deposits slow the transfer of heat from the steam across the wall thickness of the tube and through the scale deposit to the juice. Scale also causes resistance to juice flow. Both of these factors reduce heat transfer and affect steam consumption due to inefficient operation of the set.	Density is the mass per unit volume of a substance. Brix is a measure of the density of a solution. As such, brix is an indication of the amount of solid material dissolved in a solution. One litre of low density syrup will contain less dissolved solids and therefore more water than the same volume of high density syrup. A low density syrup is one with relatively little material dissolved in it and thus its brix is low. A high density syrup is one with a relatively large amount of material dissolved in it and thus its brix is high. The density of syrup from the effets and molasses from the fugals determines	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
	warning signs of potential problems					how much evaporation has to be performed by the pan. If the pan is operating at a constant evaporation rate, the strike time will be extended if low density material is being fed to the pan stage by the evaporator.	
3.2.3		• SUG202A Collect and prepare samples • SUG213A Perform standard tests on a cane sample • FDFOP2030A Operate a process control interface.	Need to look at what is relevant from these documents			Outside of scope	
3.2.4		Production issues		common causes of variation and corrective action required		too high a juice level raises the boiling point and so reduces the heat transfer and the throughput possible. Too low a juice level runs the risk of cooking the juice in the tubes. Enzyme Addition 3rd or 4th effet for removal of starch using high temperature alpha amalyse	
3.2.5		Factors that affect throughput vapour bleeding			detect and report water leaks from Evaporation operation coils	Vapour bleeding is the process of using some of the vapour coming off an effet for purposes other than heating the next effet vessel. These other purposes are typically juice heating and pan boiling detect and report water leaks from Evaporation operation coils	
3.2.6	procedures and responsibility for reporting production and performance information	Record workplace information	The importance of the log and the records	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	Typical log entries	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	
3.2.7	responding to and/or reporting equipment failure within level of responsibility completing workplace records as required	Procedures and responsibility for reporting problems	The importance of the log and the records	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	Typical log entries	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	
3.2.8	Maintenance requirements are identified and reported according to workplace	Record workplace information	Questioning and understanding that handover information has been transmitted and received	Checking by both the person finishing a shift and the new operator that both are satisfied that all relevant information has been given and understood	Video of discussion at handover showing both log book and issue	Questioning by new operator of written and verbal instructions to check complete understanding of all instructions	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
	reporting requirements						
3.2.9		Recording requirements and procedures	Questioning and understanding that handover information has been transmitted and received	Checking by both the person finishing a shift and the new operator that both are satisfied that all relevant information has been given and understood	Video of discussion at handover showing both log book and issue	Questioning by new operator of written and verbal instructions to check complete understanding of all instructions	
3.3.1	3.3 Monitor the process to confirm that specifications are met techniques used to monitor the evaporation process, including inspecting, measuring and testing as required by the process	Monitor the process and equipment operation to maintain the process within the required parameters			 Noxious (Incondensable) Gas When vapour enters a calandria it contains quantities of gases which do not condense to a liquid at the temperature of the calandria. For example, air can also enter the system through leaks in the vessels or pipe work. Carbon dioxide and other gases can come from the boiling juice. When the vapour condenses, these gases do not. Hence the other names: incondensable or non-condensable gases for noxious gases. Because these noxious gases do not condense and leave the calandria in the liquid condensate, they can accumulate inside the calandria and form a blanket around part of the tubes. This blanket of incondensable gas stops steam/vapour from getting to the outside of the tubes and so the rate of heat transfer decreases. The heat transfer rate is lowered because the heat must be transferred across the gas film, which is not good conductor of heat, before the heating steam/vapour gets to the outside of the tubes and be transferred to the juice inside the tubes. The noxious gases from the first vessel can be vented to the atmosphere because the calandria operates at a pressure above atmospheric pressure and the so the noxious gases will flow	monitor the process and equipment operation to maintain the process within the required parameters including monitoring: ▪ throughput ▪ loads on Evaporation operation drives ▪ The quantity of material to be processed is directly proportional to the flow rate of incoming evaporator syrup, or liquor. This in turn is proportional to the cane crushing rate and the soluble solids content extracted from the cane. ▪ equipment condition Condensate Removal When steam or vapour contacts the tubes in the calandria it gives up the heat energy that kept it in the gaseous state and steam or vapour turns back into liquid water. The heat energy is transferred through the tubes and heats the juice. The liquid water from the condensing steam or vapour is called condensate and must be removed as rapidly as it forms. If the condensate is not removed effectively, it can cause partial flooding in the calandria. That is the liquid water will fill part of the calandria. This will lead to a reduced transfer of heat because less area of the tubes is exposed to the steam or vapour. The performance of each vessel will be maximised if the system for the removal of condensate is working properly. Condensate from the first vessel is relatively pure water and so is normally returned to the boilers to be used as feed water. The temperature of condensate from the second vessel is quite high and reasonably pure, so it too is often sed for the boilers. The condensate from later effects is not normally used to supply feed water for the boilers because the later condensates are more likely to be contaminated with sugar. ESJ pH and Temperature The target pH for syrup is 6.5. This is the optimum pH for the crystallisation process. Syrup close to this pH gives: Massecuites which are easiest to boil. Little loss of sucrose by inversion. At higher pH, there is greater development of viscosity and colour and substantial losses of sugars. At lower pH levels, the rate of breakdown of sugar increases rapidly. The mixed juice has to be raised to a pH higher than 6.5 to produce syrup with the desired pH of 6.5. This is because of a drop in pH which occurs in the juice heaters, clarifiers and effets. This drop in pH is due to the relatively slow reaction of lime with juice.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
					out of the calandria naturally. The calandrias of the succeeding vessels operate below atmospheric pressure. The noxious gases from these vessels must be vented to a pressure less than atmospheric pressure. Typically, the gases from these vessels should be passed to the final vapour pipe entering the condenser The efficiency with which noxious gases are removed has a significant influence on evaporator operation. The performance of the set will be maximised by ensuring that the system for venting incondensable gases is working properly.	It is important to note that the pH of juices varies with temperature. The pH of ESJ cooled to room temperature will be much higher than the pH of ESJ measured at the operating temperature of close to 100°C. The optimum pH value for ESJ can only be determined by trial and error because the drop in pH across the evaporator depends on many factors. If there is no specific information available, a pH of 7.4 for ESJ is a reasonable starting value.	
3.3.2	monitoring supply and flow of materials to and from the evaporation process	Manufacturer's specifications				Manufactures recommendations v's SOP's	
3.4.1	3.4 Identify, rectify and report out-of-specification equipment, product or process outcomes according to workplace requirements	Take corrective action in response to out-of-specification results	Doc and flow chart	Various out-of-spec process and performance described	Flow chart of what to do depending on the severity of the issue	The purity of the syrup supplied from the evaporator to the pan stage has an influence on boiling control. Higher purity material is easier to boil because the syrup circulates better, is less viscous and boils at a higher vacuum (lower absolute pressure) and a lower temperature. Lower purity material has to be boiled at a lower vacuum (higher absolute pressure) to aid circulation. The lower vacuum means that the boiling temperature will be higher. The higher temperature will reduce the viscosity of the liquid (make it thinner or runnier) so circulation will be easier. Poor syrup quality also means that the syrup boils at a lower conductivity and that crystallisation and boiling are slower. Usually there is a need to boil-on with water. Fresh syrup is brighter and has a lustre while stale syrup is darker and dull.	

<table>
<tr><th>Element / (code)</th><th>Performance Criteria</th><th>Required knowledge</th><th>Requirements for LMS</th><th>Key points</th><th>Photos/Videos/Diagrams</th><th>Course Outline</th><th>Content and quiz</th></tr>
<tr><td>3.4.2 (Note redo table)</td><td>common causes of variation and corrective action required</td><td></td><td>Doc with photos</td><td></td><td>Table 4.1 Evaporator Problems, Possible Causes and Possible Solutions
<table>
<tr><th>Problem</th><th>Probable Cause</th><th>Solution</th></tr>
<tr><td rowspan="2">low steam pressure in the first effet vessel calandria</td><td>valve jammed nearly closed</td><td>repair valve</td></tr>
<tr><td>valve mechanism faulty</td><td>repair mechanism</td></tr>
<tr><td rowspan="2">vessel appears sluggish or does not boil</td><td>water logged with condensate (see note 1)</td><td>drain condensate from the vessel</td></tr>
<tr><td>non-condensable gas level high</td><td>open noxious gas valve more, or check pipe for obstruction</td></tr>
<tr><td rowspan="2">vacuum lower than normal</td><td>air leak</td><td>locate leak and effect repairs</td></tr>
<tr><td>vacuum pump faulty</td><td>check drive belts for slippage</td></tr>
<tr><td>condenser leg hotter than normal or vacuum low</td><td>insufficient water supply</td><td>check injection pumps, check supply level, check overuse of available injection water by other users</td></tr>
<tr><td>water entering vacuum pump</td><td>choked or faulty condenser, overuse of injection water (valve too far open or set point too high)</td><td>restrict valve or lower the set point</td></tr>
<tr><td>gradual decline in performance over the operating period</td><td>scaling of the internal surface of tubes</td><td>clean tubes by means of the standard cleaning procedure at the next maintenance stop</td></tr>
<tr><td>first effect boiling well, other vessels sluggish</td><td>excessive bleeding of vapour</td><td>adjust vapour throttling valve to second vessel</td></tr>
<tr><td>juice not feeding into a vessel</td><td>obstruction in pipe or faulty valve</td><td>clear pipe or repair valve (see note 2)</td></tr>
<tr><td>difficulty maintaining syrup brix</td><td>water leaking into vessel/s or broken or leaking tubes</td><td>check that all water valves are closed, test vessel/s at first maintenance stop (see note 3)</td></tr>
<tr><td>abnormal pressure reading</td><td>malfunctioning gauge</td><td>if all other conditions normal have pressure gauge checked</td></tr>
</table></td><td>Low density (low brix) syrup slows down pan throughput because it requires the pans to boil off more water. If pan throughput is reduced, the syrup tank might fill up (a liquor up) and it will be necessary for the effets to slow down. The ESJ tank might then fill up so the extraction station will have to slow down. Because the factory has slowed down, less cane is required so harvesting and transport of the cane need to be reduced as well. The entire system can be slowed if the syrup supplied to the pans is too light. Syrup feed to the pans should be as close as possible to a state of supersaturation so that pan throughput is maximised. That is, the syrup should have as high a brix as possible without actual crystals forming. If there are crystals in the syrup, there is a negative effect on the pan stage. The average size and size distribution of the crystal sugar produced by the pans will be worse.</td><td></td></tr>
<tr><td>3.4.3</td><td></td><td>Hazards and controls</td><td></td><td>Various hazards and controls
Guards</td><td>Photos of hazards</td><td>Detailed diagrams/photos of equipment</td><td></td></tr>
<tr><td>3.5.1</td><td>3.5 Follow and apply workplace cleaning and environmental procedures</td><td>Environmental issues and controls</td><td>Refer to general site induction and policies</td><td>Mill policies, Regulations</td><td>Ponds, cooling towers, trenches/channels, spills</td><td>Mill policies, Regulations for Ponds, cooling towers, trenches/channels, spills</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>Mill policies, Regulations for Ponds, cooling towers, trenches/channels, spills as related to Evaporation operations</td><td></td></tr>
<tr><td>4. Shut down the evaporation process
4.1.1</td><td>4.1 Identify the appropriate shutdown procedure</td><td>The circuit flow of this process and relationship to related processes</td><td>Flow diagram and why order of shut down is important.
Auto and manual</td><td>Order of shut down DCS and visual inspections</td><td>Evaporation operations, re-heaters</td><td>shut down sequence including massecuite pumps and re-heaters requirements of both operational and long term shut down conditions to ensure the equipment is left in a safe state for the period of the shutdown and to minimise any delays in future start up</td><td></td></tr>
<tr><td>4.1.2</td><td></td><td>Requirements when shutting down full Evaporation operations containing hot massecuite</td><td></td><td></td><td></td><td>requirements when shutting down full Evaporation operations containing hot massecuite</td><td></td></tr>
<tr><td>4.1.3</td><td>locating emergency stop functions on equipment</td><td>Shut down equipment in response to an emergency situation</td><td>Types of emergencies and where and what operator can do</td><td>Life, fire, overfilling, hot water</td><td>Stop options available depending on the situation</td><td>shut down equipment in response to an emergency situation</td><td></td></tr>
<tr><td>4.2.1</td><td>4.2 Shut the process down safely according to operating procedures</td><td>Shut down sequences</td><td>Doc + Photos</td><td></td><td>(a) Quick shutdown.
A quick shutdown generally involves shutting steam of the evaporators, after all the juice tanks and heaters have been emptied and flushed with water, then isolating the evaporator</td><td>SOP's of shut down and visual inspections of proceedings
The steps in the evaporator shutdown process is decided by how the evaporator restart is to happen at conclusion of the cleaning process. If this is a cleaning stop only and normal operation is to resume as soon as possible after the clean, a quick shutdown may be implemented. However, if an extended stoppage is expected</td><td></td></tr>
</table>

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
					vessels into “light” and “heavy” material. The heavy material is pulled, using the evaporator vacuum, into the final vessel where the material is pumped into the heavy syrup tank for use by the pan floor. The light material is ideally sent back into the clear juice tank to be used to fill the evaporators after the cleaning process to allow for a quick and efficient restart of normal operations. In this process it is normal for the clarifier to remain full during the evaporator cleaning process to maximise juice quality upon operations restart. After a quick shutdown typically all the evaporators are empty. (b) Full shutdown In this process all the sugar containing juice must be heavied up to heavy syrup before the evaporators can be shutdown. The juice tanks and heaters first need to be flushed with fresh water and emptied. The clarifier needs to be liquidated, removing all the clear juice to the mud level. When the clear juice tank empties the heavy up process begins. Each vessel must be emptied in turn, then the vessel refilled with water or the calandria spray turned on, to allow the rest of the set to continue to boil. The water for the evaporator filling should enter the evaporators via the clear juice tank and the evaporator supply pump. There should be a clear isolation within each evaporator vessel to define the water / sugar boundary. The exact processes are determined by factory specific details. After a full shutdown some of the evaporators are empty while others will contain water.	at the conclusion of the evaporator clean it is important to convert all the juice to heavy syrup before shutting down the evaporators	
4.2.2	following isolation and lock-out/tag-out procedures as required to take process and related						

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
	equipment off-line in preparation for cleaning and/or maintenance within level of responsibility						
4.2.3	requirements of different shutdowns as appropriate to the process and workplace production requirements, including emergency and routine shutdowns and procedures to follow in the event of a power outage	Shut down and clean Evaporation operations according to schedule or as indicated by equipment monitoring	Procedures, inspections, communication		pictures of cleaning Evaporation operations	SOP's of shut down and visual inspections of proceedings	
4.2.4		Record workplace information	Mill logs, verbal communication	Importance of standard procedure on delivery of information at change over via log books, verbally and visually	Mill commonly used procedure in a flow chart	Hand over, what is expected, details, verbal and written communication, scheduling for next 4 to 8 hrs that may impact on throughput	
4.2.5	The Evaporation operation station is prepared for storage in shut down mode preparing equipment for cleaning	Requirements of both operational and long term shut down conditions to ensure the equipment is left in a safe state for the period of the shutdown and to minimise any delays in future start up	Doc + Photos	Checks required prior to maintenance season schedule		Shut down and storage Evaporation operations	
4.3.1	4.3 Identify and report maintenance requirements	Recording requirements and procedures	Mill logs, verbal communication	Importance of standard procedure on delivery of information at change over via log books, verbally and visually	Mill commonly used procedure in a flow chart	DCS displays and trends during shift	
4.4.1	Maintenance requirements are identified and reported according to workplace	Recording requirements and procedures	Importance of the log and the records	Issues and maintenance program identified in consultation with appropriate staff from seasons log book issues and schedules		Checks of all equipment and documentation of required maintenance	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
	reporting procedure 4.4 Maintain workplace records in appropriate format						
4.4.2	The appropriate shutdown procedure is identified	Record workplace information	Doc explaining the importance of changeover log	Time, what happened in lead up to issue, issue, who contacted, follow up, current situation, further monitoring. Legibility, clear concise information	Log books written and electronic	Recording of information during shift. Time, what happened in lead up to issue, issue, who contacted, follow up, current situation, further monitoring. Legibility, clear concise information	

12.5 Appendix 5 - Evaporator cleaning processes content matrix

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
Overview of Evaporator cleaning processes *0.1*		The circuit flow of this process	Evaporator cleaning processes station overview. Written description with photos. Video/presentation of the sugar process and where the Evaporator cleaning processes sit. Flow Chart	Terminology. What an operator can influence. What the Evaporator cleaning processes station is trying to achieve	Flow chart of inputs output, machinery, in an ideal set up.	Aim of the Evaporator cleaning processes Parameters an operator can and cannot influence Parameters and set points why upper and lower limits Glossary terms SOP's	
0.2	Work is carried out in accordance with company policies and procedures, licensing requirements, manufacturer's recommendations, legislative requirements, codes of practice and industrial awards and agreements.	purpose and basic principles of cleaning in place (in-line) including the use and functions of caustic and acid solutions and cleaning sequence and stages as required in the workplace	Equipment and plant that is used at the Evaporator cleaning processes station	Evaporator cleaning processes equipment may include The Evaporator cleaning processes station may include: Caustic or Acid conc and diluted, hot water, steam, pumps, collection vessels, solid waste removal from base of effet, treatment and disposal of waste, environmental considerations.	Individual pictures of the key elements	Detailed diagrams/photos of equipment in Evaporator cleaning processes	
0.3	Terminology	terminology relating to the chemicals solutions used.		Add to glossary Caustic, Acids, EDTA		Caustic (NaOH solution) Ethylenediaminetetraacetic acid (EDTA) is used in the final effects as a chelating agent that softens the scale formed in these vessels to aid in their removal. Sulphamic Acid Syrup (or Liquor) ESJ Vapor Condense Condensate Noxious gas Injection water Vapor bleeds Heat transfer or HTC Vacuum: Vacuum is simply a pressure below atmospheric pressure. It is important to understand that high vacuum is a low absolute pressure (close to OkPa or -101.3kPag) and that a low vacuum is a higher absolute pressure but still below atmospheric pressure, say 91.3kPa or -10kPag. Pressure kPa.: standard atmospheric pressure (or 1 atm) is defined as 101.325 kPa.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
						Gauge Pressure: The gauge pressure of the air around us is 0kPag Boiling Temperature and Pressure: The higher the vacuum then the lower boiling temperature	
1. Prepare for cleaning *1.1.1*	1.1 Confirm chemical stocks are available to meet cleaning and sanitation requirements	Caustic, Acid, EDTA available at correct concentrations and quantities. SDS compliance.	Confirm supply of necessary materials and services	Checks required prior to filling of Evaporator cleaning processes Visual and DCS checks SOP Communication with other operators and Shift supervisor	Caustic, acid and EDTA supply tanks and dilution process. DCS of caustic, EDTA tank levels prior to starting clean.	SDS of Caustic, acid and EDTA Usually the chemical for a single chemical clean will be caustic and this will be pumped into the evaporators using the caustic supply pump located within the chemical storage area. This is a bunded, secure compound that ensure that any chemical spills can be monitored and controlled.	
1.2.1	1.2 Confirm services are available and ready for operation	Equipment purpose and basic operating principles of Evaporator cleaning processes equipment	List with photos	Evaporator cleaning processes equipment may include The Evaporator cleaning processes station may include: ▪ Supply tank of caustic and EDTA ▪ pumps ▪ batch and continuous Evaporator cleaning processes ▪ hot water and steam systems.	Individual pictures	Detailed diagrams/photos of Evaporator cleaning processes equipment	
1.3.1	1.3 Select, fit and use personal protective equipment according to workplace safety procedures	Purpose and limitations of protective clothing handle cleaning and sanitation agents safely including following correct handling and preparation procedures and use of appropriate protective clothing and equipment	Additional hazards involved with the station	Hot water for cleaning. Conveyors. Hot pipes and surfaces. Steam. Moving cams and drives. Electrical circuits. Caustic EDTA	Pictures of the key elements with discussion, chemicals and heating .	PPE specific to Evaporator cleaning processes On site safety resources eg First aid kit, eye wash, shower MSDS relevant to Evaporator cleaning processes	
1.4.1	1.4 Check equipment to confirm readiness for use according to operating specifications	Planned and non-planned cleaning program safe work procedures including appropriate signage of cleaning activities and safe handling and storage of	Length of time required, expected outcomes. Erection of safety barriers, signage requirements and specialised personal PPE Safety showers and eye wash Notification to all required personal	Safety barriers, signs, PPE	Safety barriers, signs, PPE	Evaporator cleaning processes capacity and residence time Evaporator cleaning processes station equipment Planned length of shutdown to evaluate type of cleaning required in the allotted time frame	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
		cleaners and sanitisers used					
1.5.1	1.5 Plan equipment shut down and take equipment off-line for cleaning according to operating procedures	Removal of contents of effets. Appropriate storage of contents dependent on the length of stop. access workplace information such as the cleaning schedule to identify cleaning requirements prepare equipment for cleaning including rendering equipment safe to clean, correctly positioning equipment such as valves, pipes, vents and taps, selecting appropriate cleaning cycle (CIP), removing waste and or dismantling equipment advise affected work areas of cleaning schedule and progress	Brix control of last effet Contents volume and empty tanks that are able to receive contents.	Expected length of stoppage	Tanks, valves and pipes required for transfer	The steps in the evaporator shutdown process is decided by how the evaporator restart is to happen at conclusion of the cleaning process. If this is a cleaning stop only and normal operation is to resume as soon as possible after the clean, a quick shutdown may be implemented. However, if an extended stoppage is expected at the conclusion of the evaporator clean it is important to convert all the juice to heavy syrup before shutting down the evaporators. (a) Quick shutdown. A quick shutdown generally involves shutting steam off to the evaporators, after all the juice tanks and heaters have been emptied and flushed with water, then isolating the evaporator vessels into “light” and “heavy” material. The heavy material is pulled, using the evaporator vacuum, into the final vessel where the material is pumped into the heavy syrup tank for use by the pan floor. The light material is ideally sent back into the clear juice tank to be used to fill the evaporators after the cleaning process to allow for a quick and efficient restart of normal operations. In this process it is normal for the clarifier to remain full during the evaporator cleaning process to maximise juice quality upon operations restart. After a quick shutdown typically all the evaporators are empty. (b) Full shutdown In this process all the sugar containing juice must be heavied up to heavy syrup before the evaporators can be shutdown. The juice tanks and heaters first need to be flushed with fresh water and emptied. The clarifier needs to be liquidated, removing all the clear juice to the mud level. When the clear juice tank empties the heavy up process begins. Each vessel must be emptied in turn, then the vessel refilled with water or the calandria spray turned on, to allow the rest of the set to continue to boil. The water for the evaporator filling should enter the evaporators via the clear juice tank and the evaporator supply pump. There should be a clear isolation within each evaporator vessel to define the water / sugar boundary. The exact processes are determined by factory specific details. After a full shutdown some of the evaporators are empty while others will contain water.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
1.6.1	1.6 Set the plant for the cleaning cycle	All prechecks completed, SOP reviewed, requirements to liaise/advise related work areas cleaning and sanitation requirements for work area including different levels of cleaning requirements depending on the reason for cleaning	Flow diagram of a normal cleaning cycle and DCS		Movement of juice to appropriate tanks, valves in correct positions, hot water/steam available for rinse out	Auto or manual controls. DCS and physical checks. The sugar residue in the evaporators is the greatest contaminant to the cleaning chemicals. Caustic foaming while boiling is an indication of sugar contamination in the caustic cleaning solution. To ensure that all the sugar is removed before cleaning all the drains of the evaporators should be opened and evaporator calandria sprays used to flush the sugar from the evaporators. Assuming that the sprays deliver the same volume of water per calandria surface area, the vessels with highest sugar concentration, (ie the final vessels), should be sprayed for a longer period than the initial vessels to achieve the same low sugar residual content. During a planned cleaning stop it is important to try and recover as much of this sugar content as possible so that it can be reprocessed upon the resumption of normal operation.	
1.6.2		methods used to render equipment safe to clean including lock-out, tag-out and isolation procedures	Refer to general site induction and policies	Mill policies, Regulations	Flow diagram and pictures of tags and locks	Mill policies, Regulations for Ponds, cooling towers, trenches/channels, spills as related to Evaporation operations	
2 Operate and monitor the cleaning process *2.1.1*	2.1 Undertake the cleaning process according to operating procedures	equipment settings required for cleaning and for operating respectively clean equipment according to cleaning process cycle and procedures including starting up and operating the cleaning process in both automatic and manual modes basic operating principles of process control	Auto or Manual Start up of Sequencing	Startup SOP's, services used Power, cold water, hot water, steam	Flow chart of startup	the circuit flow of this process and relationship to related processes involves the evaporators operating in a normal operation mode, with a slightly reduced vacuum. The cleaning fluid will flow from the first vessel to the final vessel as per the normal juice flow. The cleaning fluid will be continuously recycled from the final vessel to the first vessel during the chemical cleaning boil. The levels in each of the vessel will be maintained through the addition of water into each vessel using the cleaning sprays.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
		where relevant including the relationship between control panels and systems and the physical equipment					
2.2.1	2.2 Monitor the cleaning process to confirm cleaning meets workplace requirements	inspection points for cleaning and sanitation monitor the process and equipment operation to maintain the cleaning process within the required parameters consequences of contamination of process flows by cleaning solutions carry out relevant checks and inspections to confirm effectiveness of cleaning	Set points, parameters, tank levels that need to be monitored during cleaning processes	Deviation outside of set point parameters and cause and recommended procedures for rectification	DCS photos	DCS set points. High and low values. Control mechanisms. Pumps, valves, tank levels. Visual checks that parameters are being achieved. It should also be noted that near the end of the chemical boiling period, close communication with the maintenance team as to progress on all shutdown jobs should be used to determine if it is possible to keep boiling for a longer period. This is aimed at ensuring that both the maintenance and evaporator cleaning activities are conclude simultaneously ready for crushing restart to occur Window off the evaporators should also become clear after chemical clean and may be an indicator of how the clean is progressing.	
2.3.1	2.3 Record cleaning data according to workplace requirements	Record workplace information reporting and recording systems	The importance of the log and the records	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	Typical log entries	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	
2.3.2		Procedures and responsibility for reporting problems	The importance of the log and the records	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	Typical log entries	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	
2.4.1	2.4 Identify, rectify or report process non-conformance and equipment	Take corrective action in response to out-of-specification results	Doc and flow chart	Various out-of-spec process and performance described	Flow chart of what to do depending on the severity of the issue	the effect on C molasses purity of variation in: ▪ end of cooling and reheating temperatures ▪ residence time	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
	faults according to workplace procedures						
2.4.2		Report and/or record corrective action as required	The importance of the log and the records	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	Typical log entries	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	
2.4.3		Common causes of variation and corrective action required	Doc with photos		Farleigh trouble shooting guide	the risks and consequences of pipe failure, valve leakage, solid waste removal from base of effet	
3 3 Dispose of waste and return plant to operating condition *3.1.1*	3.1 Flush and dispose of cleaning chemicals from plant according to workplace environmental procedures	Environmental issues and controls environmental consequences of incorrect waste disposal procedures	Refer to general site induction and policies	Mill policies, Regulations	Ponds, cooling towers, trenches/channels, spills	Mill policies, Regulations for Ponds, cooling towers, trenches/channels, spills Residual cleaning chemical in the vessel should be removed by using the calandria sprays with the fluid being stored into the cleaning chemical tank. After cleaning has been completed using speciality chemicals the disposal is different for each chemical. Acid. For acid cleans it is recommended to dispose of the acid from the process system, possibly to the wastewater treatment process. The acid cleaning chemical should not be mixed with the caustic cleaning solution under any circumstance. EDTA. The cleaning EDTA is preened in the basic form. Any residual chemical may be mixed in with the caustic cleaning solution. Any residual impact this chemical will have will be utilised in subsequent cleaning processes. Caustic. It is important that the caustic cleaning tank has a steeply sloping conical base to allow the collection and removal of any scale or “sludge” from the cleaning chemical. This caustic sludge may be used in other factory processes that do not interact with the sugar making process flow. Boiler ash water and waste water pH control have utilised caustic sludge with good effectiveness as a replacement to concentrated caustic or lime pH control. It is important to remove any solid scale from the base of each evaporator vessel. If this scale remains in the vessel it is available for redissolution and then to reform on the heating tubes. The scale can be removed by opening the lowest valve or door on each vessel and then using the calandria sprays to remove the scale. An efficient valving or door opening system is required to undertake this activity in the minimum timeframe under safe operating conditions.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	Content and quiz
3.1.2		types of waste generated by both the production and the cleaning process and related collection, treatment and disposal requirements sort, collect, treat, recycle or dispose of waste	Refer to general site induction and policies	Mill policies, Regulations	Video of techniques used	Mill policies, Regulations for Ponds, cooling towers, trenches/channels, spills as related to Evaporator cleaning processes	
3.2.1	3.2 Plant is set up to meet operational requirements	Return plant to operational requirements Restart of plant as per SOP and current supply of ESJ	Mill logs, verbal communication	Importance of standard procedure on delivery of information at change over via log books, verbally and visually	Mill commonly used procedure in a flow chart	Checklists should be utilised to ensure that all the evaporator valves and door are in the correct position before attempting an evaporator restart. If this process was after “quick” shutdown, the “light” material can be used to fill the evaporators and the evaporators started slowly to start to achieve full final brix as soon as possible to facilitate an uninterrupted crushing process restart. Hand over, what is expected, details, verbal and written communication, scheduling for next 4 to 8 hrs that may impact on throughput	

12.6 Appendix 6 - Operate a Pan Station process content matrix

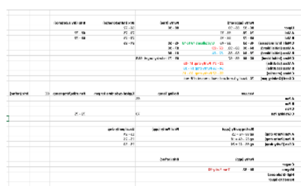
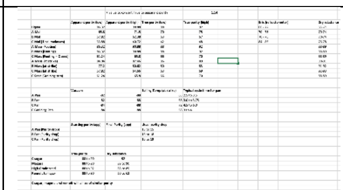
Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
0.1.1 Overview of Pan operations	Overview of Pan operations	The circuit flow of this process and relationship to related processes terminology relating to pans process	Pans operation station overview. Written description with photos. Video/presentation of the sugar process and where the Pans operations sit. Flow Chart	Terminology. What an operator can influence. What the Pans operations station is trying to achieve How a very good Pans process station and operator will function. PPE specific to the Pans operation	Flow chart of inputs output, machinery, in an ideal set up. See if can set up a video to show what saturation and supersaturation is. May have to do this by showing feel? Or use idea from below Idea beaker 100mls water add sugar till no more will dissolve. To get more to dissolve add heat or increase vacuum (use syringe to reduce pressure with excess sugar in the solution which should dissolve the excess)	The pan stage is where, as economically possible, the liquid sucrose is converted into solid sucrose crystals.	
0.2 terminology	*Terminology* terminology relating to sugar and molasses quality	Some terms will be in terminology but limited use in notes.	Alphabetical order	Glossary: (this will require a through check with operators as terminology used is very different from mill to mill even within the same company) Exhaustion Brix The measure of dissolved solids in sugar juice, liquor or syrup using a refractometer, otherwise referred to as refractometric dry solids Refractometer brix This needs to be the same terminology as per the other units. May include that massecuite brix ranges from 86 to 92 Dry substance Pol Purity: (The true purity is the sucrose content as a percentage of the dry substance or dissolved solids content. The solids consist of sugar plus non-sucrose components such as invert, ash, and colorants. Apparent purity is expressed as polarization divided by refractometer Brix, multiplied by 100.) Add a definition = formula of sugar purity here. Batch pan CVP Continuous Vacuum Pan Liquor/Syrup (Note: Some factories refer to syrup as liquor and A and B molasses as A and B syrup respectively) Massecuite Molasses Mother Molasses Magma High grade seed Footing Boil back Strike (not used by mills spoken to so far) or Dropping/ May also include skip, ie strike, skip, batch Proof sampler/stick Conductivity/Resistivity Ramping	Massecuite with clearly defined crystals	Massecuite is a mixture of the sugar crystals which have been grown on the pan stage and any remaining liquid which is known as different types of molasses. A massecuite consists of A sugar and A molasses. B massecuite consists of B sugar and B molasses. C massecuite consists of C sugar and C molasses.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
				Set point Twinkle sugar, ball sugar, Mill roll Slurry, RMS, Rod Mill slurry. Crystal Content Sucrose degradation, reducing sugars, inversion Cut over; The act of transferring massecuite from one pan to another is called a "cut over". A pan B pan C pan Graining pan High grade seed pan Magma pan Crystalliser Saturation/Supersaturation/Undersaturated (brief but do not examine or use in general text as not used by operators that I have spoken too) Operators tend to used "weight" of massecuite ie heavy or light. Need to relate these terms to supersaturation			
0.2.2 Overview of Pan operations (continued)		Keep this simplified building on 0.1.1		Purity early /mid/ late season The higher the purity the less impurities Circulation in a pan, each pan may have there own way of boiling/heat transfer but some things are common	Photos/videos of pan stage operation in general	Syrup has a high purity. This means that virtually all the solids which are dissolved in the syrup are sugar (sucrose). The small amount of solids other than sugar, which are dissolved in the syrup is unwanted impurities in sucrose crystallisation. The high syrup purity, means it is not economically or practically possible to convert all of the dissolved sugar into crystal sugar in one attempt. The massecuite would contain far too much crystal and not enough molasses. This would make the massecuite too thick to run out of the pan. For this reason, the crystallization process has to be done in stages. The three stages of the production in Australia are A, B and C massecuite. However, there are other stages to this that do not produce product sugar or exhaustion from final molasses A Sugar To produce A sugar, the syrup is fed into a vacuum pan which contains a portion of material called a footing. A vacuum pan is a vessel, heated usually with low pressure steam, which is used to boil liquids under vacuum. For A sugar, the footing is usually prepared in the magma (Magma is defined in the definitions) Need to have already clearly defined this term before using. sugar making process, ie with the C mass. Then magma, high grade seed, then A massecuite (90% syrup + 10% A mol) and B massecuite is similar to A massecuite but has more (up to 50%) of the material being fed on as A molasses) pan and already contains small sugar crystals suspended in a liquid. When heat is applied to the pan, some of the water is boiled off and the sugar dissolved in the syrup deposits out onto the surface of the small crystals causing them to grow larger. The resultant mixture of crystals and liquid is called A massecuite. After A massecuite has reached the correct concentration, it is dropped into a receiver . The receiver acts as a holding vessel.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
						The A massecuite is then separated into A sugar and A molasses by spinning in the high grade fugals. The A sugar is then dried and sent to the sugar bin for shipment. B Sugar A molasses still contains a large amount of dissolved sugar which can be recovered. A footing is drawn into a pan again. This time A molasses is used to grow the crystals. This produces B massecuite which yields B sugar and B molasses. The high grade fugals separate the sugar from the molasses. The pans used to make A and B massecuite are called high grade pans. B sugar is also sent to the storage bin ready for shipment. Shipment sugar consists of A and B sugar. C Sugar B molasses also contains recoverable sugar and so a third recovery boiling is carried out. The end result of this boiling is called C massecuite. This is separated into C sugar and C molasses by the low grade fugals. The C sugar crystals are a smaller size and a lower quality than A and B sugar. C sugar is not used for product sugar. It is returned to the pan stage to be processed again. Product Purities/ Boiling Formula A boiling formula specifies how much syrup, A and B molasses and magma are needed to produce massecuite of the required purity. The boiling formula is varied throughout the crushing season due to changes in cane composition. These changes result in varying amounts of impurities in the syrup supplied to the pan stage from the evaporators. Early and late in the season, there are more impurities in the cane. These impurities leave the factory through the final molasses. More impurities means more molasses, resulting in more C massecuite to be produced. This in turn, may limit the capacity of the whole pan stage. During the middle of the season, when there are less impurities the high grade pans may be the limiting step in the throughput of the pan stage. High grade pans produce A and B massecuite. The extent to which problems occur will depend on the capacity of the pan stage relative to the rest of the factory. This varies from factory to factory.	
0.3 Overview of Pan equipment	*purpose and principles of pan station operation, including the principles of crystallisation that may relate to operation of batch and	Generalised including batch and continuous pans	List with photos	Pans operation station equipment Pan equipment may include: ▪ Injection pump ▪ Vapour condensers and vacuum pump ▪ DCS and circuits ▪ syrup tank ▪ Batch pans ▪ Continuous pans ▪ Receivers ▪	Photo of raw sugar storage shed/bin ▪ Injection pump ▪ Vapour condensers and vacuum pump ▪ DCS and circuits ▪ syrup tank ▪ Batch pans ▪ Continuous pans ▪ Receivers ▪	The purpose of the pan stage is to produce as much raw sugar as possible from the syrup supplied form the evaporators. Syrup is a thick, amber coloured liquid. It is made in the evaporator, by boiling off some of the water from the juice but not to a point where crystals could grow. The main aims of the pan stage are to: • Recover as much of the sugar from the syrup (as economically possible). That is, to exhaust the incoming syrup to a final molasses containing the lowest economic amount of sugar possible.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
	continuous pans					Exhaustion is an indication of the fraction of the sugar in a liquid which is recovered as solid, crystalline sugar by the pans and fugals. High exhaustion, is (maximum recovery of crystalline sugar) is desirable. • Produce crystal sugar of the right quality. That is, to make sugar crystals of the correct size and shape. To do this a pan boiler will know the various pieces of equipment and the correct operation of them. These will include ▪ Injection pump ▪ Vapour condensers and vacuum pump (explain what each of these equipment does and how this is achieved. Ie how does a vacuum pump (liquid ring and reciprocating) create a vacuum) not sure this is required at operator level) ▪ DCS and circuits ▪ syrup tank ▪ Batch pans ▪ Continuous pans ▪ Receivers ▪ A good pan boiler operator requires good knowledge, repeatable skills, ability to use DCS controls and visual conformation of changes, an understanding of the "science" of growing sugar crystals and the use of their senses, especially feel, sight and hearing. They will have very good knowledge of the equipment they have in their factory and the best way to use each pan and differences between them.	
0.4 Overview of steam usage and the relationship between boiling point and pressure as applied to Pans	an understanding of the principles of steam Pressure, measuring, scale, positive – negative, boiling point *relationship between boiling point and pressure in the pans station	Steam , vacuum, temperature	Use from effet module what is appropriate	Steam, Vacuum, Boiling temperature	Steam valve, steam and stack general shot of mill	Copy from effet module and apply to pans Due to the vacuum created by the condenser, the pans boil at about 65°C. The lower boiling temperature means that: • Sucrose degradation/inversion/reducing sugars is reduced. • Circulation of material in the pan is improved. • The feed material can usually be drawn into the pan without a pump being required. • Colour formation is limited	
0.5.1 PPE	select, fit and use personal protective clothing and/or equipment	Purpose and limitations of protective clothing	Additional hazards involved with the station	Hot water for cleaning. Hot pipes and surfaces. Hot ESJ Steam. Electrical circuits.	Pictures of the key elements with discussion, burns .	PPE specific to Pans operations On site safety resources eg First aid kit, eye wash, shower MSDS relevant to Pans operations	

<table>
<tr><th>Element / (code)</th><th>Performance Criteria</th><th>Required knowledge</th><th>Requirements for LMS</th><th>Key points</th><th>Photos/Videos/Diagrams</th><th>Course Outline</th><th></th></tr>
<tr><td></td><td>key work health and safety requirements when operating a panning process:
• correct use of personal protective clothing and equipment purpose and limitations of protective clothing and equipment</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>0.5.2</td><td>Safety aspects of the pan station</td><td>Specifics to pans</td><td></td><td><table>
<tr><th>Pipeline Identification/ Item of Plant</th><th>Colour</th></tr>
<tr><td>Water (injection water, condensate, hot water)</td><td>Green</td></tr>
<tr><td>Steam (HP, LP, vapour)</td><td>Silver</td></tr>
<tr><td>Fire Fighting</td><td>Red</td></tr>
<tr><td>Air (compressed air, vacuum)</td><td>Light Blue</td></tr>
<tr><td>Acids and Alkalis (cleaning chemicals)</td><td>Violet</td></tr>
<tr><td>Electricity (conduit, cables)</td><td>Orange</td></tr>
<tr><td>Syrup</td><td>Cream</td></tr>
<tr><td>Massecuite and Magma</td><td>Rust</td></tr>
<tr><td>Molasses</td><td>Ochre</td></tr>
<tr><td>Vapour Pipes and Condensers</td><td>Straw</td></tr>
<tr><td>Safety Hazard, Guards, Aisle Markings, Handrails</td><td>Yellow</td></tr>
<tr><td>Lubricants</td><td>Golden Brown</td></tr>
</table></td><td></td><td>Some of the safety aspects to be considered when working on the pan stage are:
Steam
All steam valves should be slowly opened to allow any condensate that has built up in the pipe to be moved forward slowly be a gentle flow of steam. If the steam is turned on full straight away, the condensate will be carried forward at a very fast rate and hit the tubes with a great force. This is called water hammer.
Vacuum
Vacuum is capable of great destructive force. This is especially so if applied to tanks not designed for it. For this reason safety procedures should be followed closely to ensure safety.
Pressure and vacuum can be dangerous. Any faults observed concerning steam or vacuum should be reported to the appropriate person immediately.
Hearing
There may be noisy areas within the pan stage. All directives concerning hearing protection equipment and hearing protection areas must be followed.
Colour Coding Of Pipes
Pipes that carry the same materials are usually painted the same colour. Each material has its own characteristic colour. It is important to know the colour coding of pipes so that incorrect valves are not opened.
Figure shows the colour coding that are usually found in sugar factories. There may be some differences in the colour coding scheme in individual factories.
Procedural and factory regulation safety must be observed at all times, regardless of the task you are performing. This is to ensure personal safety and the safety of others.
Steaming out to remove massecuite from pipes – Maillard rection is most important as this has caused deaths in Au.</td><td></td></tr>
</table>

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
			Drains	Black			
0.5.3	isolation, lock-out and tag-out procedures and responsibilities key work health and safety requirements when operating a panning process: *lock-out and tag-out procedures	Lock out and tag out procedures	Refer to general site induction and policies	Mill policies, Regulations	Flow diagram and pictures of tags and locks	Mill policies, Regulations for Ponds, cooling towers, trenches/channels, spills as related to Pans operations	
0.5.4	key work health and safety requirements when operating a panning process: • hazards and associated control measures	This should be the bases of all decisions in regard to safe operation; take 5 system by Wilmar and similar methods in other milling companies	Hazard pyramid	Hazard pyramid	Hazard control pyramid diagram	Hazard Pyramid diagram	
1 Prepare the pan station for operation *1.1.1*	1.1 Liquor and molasses are available to meet production requirement access workplace information to identify production requirements	Conducting relevant pre-start checks with operational personal Current operating throughput, schedule, limiting factors. DCS what it is, does and how it relates to the physical equipment	Confirm equipment status and condition Visual and DCS checks	What to look for. Checking of prior entries to log book 	Operator on two way/m ph DCS showing availability of cold water, hot water, and power		

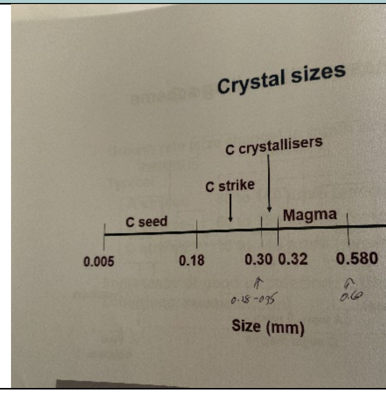
Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
1.1.2	conducted pre-start checks and confirmed equipment status and condition	conducting pre-start checks, including: inspecting equipment condition to identify any signs of wear selecting appropriate settings and/or related parameters cancelling isolation or lock-outs as required confirming that equipment is clean and correctly configured for processing requirements positioning sensors and controls correctly ensuring any scheduled maintenance has been carried out confirming that all safety guards are in place and operational		DCS and visual are both highly important	Operator checking on pan floor	conducting pre-start checks, including: • inspecting equipment condition to identify any signs of wear • confirming that equipment is clean and correctly configured for processing requirements • positioning sensors and controls correctly • ensuring any scheduled maintenance has been carried out • selecting appropriate settings and/or related parameters • cancelling isolation or lock-outs as required • confirming that all safety guards are in place and operational • Pan stage pre- start checks usually involve a water boil. This checks vacuum and steam control with minimal risk.	
1.2.1	1.2 Services are confirmed as available and ready for operation services used confirming supply of necessary materials and services	ESJ supply, Brix Steam, water(injection), power,	Confirm supply of necessary materials and services	Checks required prior to filling of Pans operations Visual and DCS checks SOP Communication with pan operator and Shift supervisor	General shots of some of Steam Power Injection Water Balance water Liquor/Syrup A mol B mol C mol Magma Additives for process Slurry	Services will not only be available but the operator will/may be required to communicate with boiler station in regards to potential requirements for steam for the pan station. The purity, brix, and qualities of the input materials will also need to be obtained through good communication with the fugal operator.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
1.3.1	1.3 Equipment is checked to confirm readiness for use cleaning and sanitising equipment according to workplace procedures *equipment purpose and basic operating principles of pans station equipment, including vacuum pumps and condensers	Conducting relevant pre-start checks all safe guards are in place equipment is operational	Confirm equipment status and condition Visual and DCS checks	What to look for. Checking of prior entries to log book Visual inspection, checking that DCS and physical conditions are correct. Eg Valve positions, tank levels, vacuum	DCS shots of different screens from various mills	Equipment check will include both DCS and visual checks of tanks, condensers, valves, pumps, stocks, receivers. Correct position on valves all inspection and discharge doors closed confirming that all safety guards are in place and operational	
1.4.1	1.4 The pans station is set up to meet production requirements	Relate this back to services and materials now and for future production within foreseeable time frames		Current and future stokes in foreseeable future	DCS and visuals of Current stocks, prediction of future stocks based on the massecuites to be fugalled, A mol, B mol and Liquor stocks. A/ B production requirements Variation throughout the season, after a stoppage, wet weather, maintenance, CCS levels, Purities, Brix, Impurities	Current stocks, future stocks, A mol, B mol and Liquor stocks. A/ B production requirements Variation throughout the season, after a stoppage, wet weather, maintenance, CCS levels, Purities, Brix, Impurities	
1.4.2	*sugar industry quality standards for each brand of sugar			Types of sugar and pol and moisture requirements	Australian Grades of Raw sugar for refining. Extra High Pol, QHP, Z = 99.6 Very High Pol, IHP, Z = 99.3 High Pol, Brand 1, Z = 98.9 Low pol, JA, Z = 97.85 Shots of different pol sugars	Australian Grades of Raw sugar for refining. Extra High Pol, QHP, Z = 99.6 Very High Pol, IHP, Z = 99.3 High Pol, Brand 1, Z = 98.9 Low pol, JA, Z = 97.85 Quality parameters Pol; (measure of sugar quality) Moisture; (creates acceptable storage and handling) Temperature; (storage and colour formation) Starch; (Increases cost of refining by impeding filtrability) Dextran; (reduces crystal growth rates and increases elongation which are difficult to fugal) Grist (Fines); (Small crystals in large numbers cause difficulties in the affination stage of refining) Filtrability; (Ability to pass through the carbonification process in a refinery) Colour; (major quality factor for refiners) Ash; (Inorganic salts mainly Potassium, Calcium and Magnesium)	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
						Floc (GMA); (Complex mixture of polysaccharides and other compounds that can lead to a cotton ball type formation in some bottled soft drinks) Need to explain the limits for BR1 and state the other brands have similar quality requirements	
2 Operate and monitor pan station *2.1.1*	2.1 The pan station is started up and operated according to company procedures confirm equipment status and condition basic operating principles of process control, including the relationship between control panels and systems and the physical equipment	Operation and monitoring of equipment and processes typically requires the use of control panels and systems. using process control systems according to workplace procedures	Doc with photos	DCS	Video of changes being made to a DCS The target pH for syrup is 6.5. This is the optimum pH for the crystallisation process. Syrup close to this pH gives: & Massecuites which are easiest to boil. Minimum development of undesirable compounds and colour. & Little loss of sucrose by inversion. (Check what most mills use here Ph may be above 7 to reduce inversion. 6.5 is a compromise between a suitably high ESJ pH and the fouling rates at the evaps. Ideally Syrup Ph would be 7.4.)	Look at A pan first assuming we have stocks of magma and liquor. Assume we have magma and this magma has been produced will be discussed later in the course. A pan footing (magma)+ Liquor => (HG fugal) Product sugar+ A mol B pan footing (magma) + Liquor + A mol => (HG fugal) Product sugar + B mol May leave this to a separate section as it may cloud the description of pan operation, whereas this is really purity control. (can have good pan operation and poor purity control) DCS changes and comparing to visual changes and lab results to see that changes are being achieved The instrumentation on the pan station should be well known Operation of an pans requires control of: Steam supply Pressure/vacuum Footing and level in comparison to calandria Brix of the liquor. Brix of A Mol, B Mol, C Mol Purity of Liquor, A mol, B mol, C mol Required purity of pan blends Batch Pan Start Up Procedure Step 1. The pan should be clean before start up is commenced. Step 2. The discharge valve is closed. Step 3. The cut over valve is closed. Step 4. The manual vacuum breaker is closed. Step 5. The valve to the vacuum pump is opened. Step 6. The injection water isolation valve is opened. Step 7. Set point on the vacuum controller is selected, and vacuum is raised. Step 8. Set point on the conductivity controller is selected. Feed valve is shut in manual Step 9. The correct feed switch position is selected. Step 10. Footing is drawn in to the correct level. Step 11. Steam is turned on after the heating surface has been covered with material to at least 200mm above the top of the tube plate. This prevents caramelisation of sugar due to lack of circulation. Caramelisation is when sugar is "cooked" due to too much heat. (Check steps 1 – 11 are good with operators then add extra steps as required Feed on = increase in crystal size using conductivity control. Heavy up Dropping Cleaning	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
						Reset Restart.) Continuous Pan Start Up Procedure (Not Empty) Step 1. Ensure the vacuum breaker is closed. Step 2. Open the valve to the vacuum pump. Step 3. Then open the injection water isolation valve. Step 4. Raise the vacuum carefully to avoid frothing (If there is material in the pan.)? Step 5. Apply steam slowly to the first module of the calandria. Step 6. When boiling freely, apply steam to the other modules, working toward the outlet of the pan. Step 7. Start the addition of seed to the first cell, ensuring adequate circulation at all times. Step 8. Commence discharge of massecuite from the final cell, when the desired conditions have been achieved. Check what are the conditions on screen for everything to be good and as normal. (Check steps 1 – 8 are good with operators then add extra steps as required) If the continuous pan is empty, there are two approaches. One is to fill the pan with material prepared separately in a batch pan and proceed as above. The other approach is to divide the pan into multiple modules. The calandria is usually partitioned into distinct segments each having its own steam feed. Step 1. Fill the first module and start it boiling. Start increasing the level to the massecuite is at maximum level. (can be up to 1000mm above top tube plate) Step 2. Transfer some material to the second module, until the level in the first lowers to 200mm above the top tube plate. It may/will probably be held here. These steps may need to be repeated. This is because it is not possible to transfer enough material from the first module to cover the calandria in the second module. Step 3. Continue as above until the calandria in the second module is covered by at least 200mm of massecuite. Boiling and feeding of material onto the massecuite of that module can then start. Step 4. Continue as above until all modules are boiling. (Check steps 1 – 4 are good with operators then add extra steps as required)	
2.1.2	*prepared slurry for seed production	Twinkle, mill rod		How slurry is prepared. Commercially Ball Rod Additives Alcohol/Vegetable oil	Graining video, stretch of molasses prior to graining. Video of addition of slurry Video of pre prep of slurry by through mixing Not sucking in air with slurry	Graining Procedures There are two basic procedures for preparing seed material or graining: magma preparation and slurry addition. These are normally used as seed for high and the low grade pans respectively. Magma Preparation Magma is used as the seed for high grade pans May need to discuss purity control separately . Purity is a measure of the amount of non-sugar solids dissolved in some material. Low purity means that there are more impurities or	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
						non-sugar solids present than would be found in a higher purity product. If magma purity is too low, more molasses will be returned to the pan stage with the C sugar magma. This is because of the increased impurities present. Or Discuss graining not purity control, (Check with operators) The molasses has to be reprocessed by the pan stage. So low magma purity slows down the production of massecuite by the pan stage. Slurry Slurry is used as the seeding material for low grade pans. It is prepared by grinding up white sugar crystals in a special liquid. This liquid is not water and will not dissolve the sugar. The slurry must contain the correct number of particles in order to maximise the crystal content of the strike. In an ideal pan stage, the number of sugar crystals leaving the factory and the number of crystals in the prepared slurry are the same. That is, no new crystals should be grown. All the pan stage should do is grow crystals which are supplied in the initial slurry addition to the C massecuite Slurry is used to seed the low grade pans. The C sugar from the low grade pans are used in the footing for the high grade pans. The preparation and addition of slurry to seed low grade strikes is very important. It can have a major impact on pan stage operations. Poor slurry can result in a wide range of crystal sizes in the C sugar. This range in size will spread to the high grade massecuites, thus decreasing the quality of the sugar. The addition of incorrect amounts of slurry is the same as introducing incorrect amounts of crystals for growth in low grade pans. Too many crystals will result in a grain size smaller than desired. This can be corrected in high grade strikes by varying the normal schedule or by allowing for the additional time required to regrow the crystals. If not enough slurry is added, fewer crystals will form than first anticipated. This can be corrected in the high grade strikes, by deviating from the pan schedule. If the crystal numbers are consistently too low, there may be insufficient magma for seeding the high grade strikes.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
2.1.3	Crystal growth	Crystal sizes in the various stages of production				Look at the various stages and size of sucrose crystals as it grows from seeding/graining pan through to the A pan	
2.1.4	*started up and operated equipment in both automatic and manual modes	Follow start up procedure	Auto or Manual Start up Sequencing	Startup SOP's, services used Power, cold water (injection), hot water, steam	Flow chart of startup Cut Over and Pan Turn Around Procedures Procedures involved in the operation of a batch pan include: • Preparation of the pan. • Raising vacuum., • Checking vacuum • Introduction of the footing. • Initiation of the steam flow and feed. • Run up of the strike. Run up is the feeding of syrup and molasses to build up the footing to the final volume of massecuite. • Cut over of material. Cutting between pans is the process where massecuite is transferred in whole or in part from one pan to another. Cutting over is necessary with batch pans to allow for the increasing volume as the sugar crystals grow. • Heavy up of the strike. Heavy up is the final stage of crystal growth before the massecuite is dropped. • Dropping sequence. • Clean up of the pan. All the operations except run up and heavy up of the strike are called turn around sequences. A pan is productive only when it is actually boiling off water to grow crystals. In this sense, cutting over, discharging and restarting are all non-productive activities.	Startups occur: At the start of the season After weekend stops if crushing is not continuous After maintenance stops After a short factory stop Many factors, such as tank and receiver levels, are involved in startup. Each of the above cases will have a different set of priorities. The syrup and molasses storage tanks levels and the crystallizer levels have to be considered. They will determine whether the high grade or the low-grade end is given priority when starting up. Pan Stage Start Up Procedure Step 1. The cutting line drain valve and all pan drain line valves are closed. Step 2. Receivers are checked to ensure they are empty of water or massecuite. Step 3. Basins on pans for washing slides are filled. Step 4. Pan stage microscope is set up Step 5. Log sheets set out. Step 6. All valves from syrup mains are checked. Step 7. Isolation valves from syrup and molasses tanks are opened. Step 8. All cutting valves are checked to ensure they are closed. Step 9. Vacuum pumps are started. Step 10. Pan levels are checked for frothing. If there is no frothing evident, vacuum is slowly brought up. Step 11. The steam valve is then opened slowly to start boiling. Step 12. Empty pans are given a good steam out with the doors open. This is to warm up the pan. Step 13. The discharge valve (pan doors), are then shut and a check for leaks carried out. (add extra step here as required SRM module stops description here)	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
					These non-productive activities should be limited, thus providing the pan with the greatest production potential.		
2.1.5	safely operated, monitored and adjusted the process and equipment operation undertake visual inspection and conduct tests to monitor characteristics such as: stirrer load pan vacuum sugar crystal size and distributio n pan station product purities pan station stock levels including receiver stocks high grade fugal times including spin and wash times steam pressure boiling formula	Massecuite, CC, Mother molasses	Safe operation to be re visited here		Cut Over of Material Procedure There is considerable volume increase associated with the growth of the sugar crystals increases during boiling. This is why the cells in a continuous pan usually increase in size through the pan. Usually how many cuts are required to grow from C sugar to HG massecuite? Expansion ratio - explain In the case of batch pans, crystals are grown in one pan and then transferred to a larger pan to accommodate the increase in volume. Alternatively, some of the massecuite in a pan may be transferred to another pan. When part of the massecuite is transferred to a different pan, the remaining massecuite and that transferred to the other pan are then grown further in the separate pans. May require a basic description of all of the pan actions, Start, Run up, cut, drop and scheduling before the detailed descriptions During cut over material is transferred from one pan to another. This is done through a system of cut over pipes or a single cut over main. The cut over main has branch pipes to the bottom of each pan. The massecuite is not pumped between the pans. Rather, the massecuite is sucked from the low level vacuum pan to the high level vacuum pan. This is made possible by a deliberately created difference in vacuum between the two pans. When cutting, care must be taken to avoid rushes of air. These cause material in the pan receiving the cut to be carried into the condenser.	The pan operator will monitor a number of variables throughout each pan cycle for batch pans or changes in a continuous pan. Growing up Sucrose Crystals review of terminology (use a diagram to show this) Massecuite = Sucrose Crystals + Mother Molasses Mother Molasses = The liquid that surrounds the sucrose crystals that contains sucrose (in liquid form) and impurities. Sucrose Crystals number and size= Crystal Content (CC) Typically, an A massecuite will run up with a crystal content of 35 to 45 per cent but at the dropping point the crystal content will have risen to about 55 per cent. As purity decreases, the achievable crystal content at dropping becomes lower. B massecuite might have a crystal content of 47 to 50 per cent when dropped while the crystal content of a C massecuite would only be about 30 per cent when discharged to the crystalliser. If a batch ban has a stirrer, then then load (amperage or watts) will be monitored to ensure good circulation in the pan. Current usually only changes during heavy-up Each batch and continuous pan will have its own condenser. The condenser provides the vacuum in the pan and the injection water and vacuum pressure while require continual checks. The steam supply to the pan calandria is critical to the heat transfer to the contents of the pan. Both pressure and temperature of the steam needs to appropriate with good condensation and noxious gas removal from the calandria. The heat in the pan causes the contents to boil which evaporates water as a vapor, circulates the contents of the pan rising as it heats and falling as it cools thus creating circulation and the greatest contact possible between the liquid sucrose and sucrose crystal. As water is evaporated the liquid contents will go from unsaturated to saturated to supersaturation. To grow sucrose crystals the massecuite (or more exactly the mother molasses) needs to be supersaturated, that is the solution cannot evaporate any more water unless the sucrose joins up with a sucrose crystal. (Look at set points and conductivity in relation to supersaturation and use terminology that operators use) If the mother molasses has too much water evaporated from it and the solution goes "past" ideal supersaturation then nucleation (or false grain or grist) can occur. The pan operator will use the DCS, viewing windows, physical checks, proofs and microscope to monitor the process in each pan. Pan Dropping Procedure Throughout the pan cycle the operator will monitor all variables within the pan via the DCS and through the pulling of proofs. This is critical prior to dropping the contents of a pan into a receiver so that crystal growth is maximised, exhaustion of the sucrose from liquid to solid is maximised but ensuring that the massecuite can still flow and be fugalled are equally as important.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
	pan circulation supersaturation equipment condition				Step 1. Open the valve to the vacuum pump. Step 2. Open the injection water valve. (Steps 1 and 2 raise the vacuum in the pan to receive the cut.) Step 3. Shut off steam to the pan being cut from. Step 4. Reduce the vacuum in the pan being cut from. Except when doing Running cuts – explain differences. Step 5. Open the cut over valves to allow transfer of the massecuite. Step 6. Close the cut over valves when the desired amount of massecuite has been transferred. Step 7. If a cut was a total cut, the empty pan should be cleaned. A total cut is when all the material is emptied from one pan.	Find out what are the key indicators that the pan is ready to drop? Step 1. The receiver is checked to see if it is empty and its valve is shut. Step 2. The fugal operator should be notified. Step 3. Steam is shut off. Step 4. Injection water is shut off from the condenser. Step 5. The vacuum pump is isolated. Step 6. Vacuum is broken and the pan opened to the atmosphere. This is done by opening the vacuum breaker valve. Steam may also be used to break vacuum. When the vacuum drops to 2 inches Hg,(Check what measurement is used or whether the pan goes back to atmospheric pressure) the tonnage should be measured and recorded. Step 7. The pan discharge door is opened. The massecuite is then run out into the A or B receiver or the crystallizer (C massecuite) below. Pan Wash Out and Steam Out Procedure Step 1. The steam out valve is opened. The pan is steamed out for a preset period or until the pan temperature reaches a preselected value. Step 2. Pan doors are closed. Step 3. Steam out valve is closed. Step 4. The pan is sprayed out. Step 5. Pan washings are often discharged via the cut over lines to the washings tanks. Step 6. The injection water is turned on. Step 7. Vacuum pump is turned on. Step 8. Vacuum is raised. Step 9. Full vacuum must be reached before cutting in. Contents from one pan are "sucked" in to another pan with a lower vacuum. Any flushings left in the pan will be boiled down when the next charge is pulled in.	
2.1.6	*controlled station throughput and A/B balance to meet factory throughput through pan scheduling	Scheduling, basic flow diagram	Regular checks and sampling of contents of pans required		Syrup Purity(apparent) 85 - 90 Brix (refrac) 66 - 72 A mol Purity(apparent) 83 - 90 Brix (refrac) 70 - 75 B Mol Purity(apparent) 78 – 84 Brix (refrac) 70 – 75 Final Molasses Purity(apparent) 58 – 65 Brix (refrac) 84 - 86	A pan schedule sheet is a diagram or instructions of pan usage over a shift. There is a lot of information is contained in a pan schedule. Good scheduling balances material flows in the pan stage and maximises pan stage throughput in doing so, it ensures that all pans are operating. Therefore, all pans should be boiling massecuite and not left idling. Scheduling Another aim of the pan stage is to produce shipment sugar of the correct grain size. This sugar is produced from a footing of C sugar magma. The quantity of massecuite dropped from a unit volume of magma is between fifteen to thirty times. This means that there are several steps in crystallization from seed sugar to shipment sugar. At each step, part of the massecuite is cut across to other pans. These are then fed up on syrup or molasses before being cut again or dropped. High grade footing is first charged into a pan and then cut over to other pans. Then it is (check terminology	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
						"Fed using syrup/ molasses, controlled by conductivity" fed up again and cutover to other pans. Finally, it is fed up once more and then dropped. Pan schedules are plans of how the pan stage should be operated to achieve maximum capacity. There are many variations of schedules. These are planned according to the sizes and boiling characteristics of the pans available at each mill. However an efficient and simple schedule will normally have the following characteristics: • A reasonably constant massecuite/magma ratio for each strike. • Uses pans to their best capacity and does not allow for idling of pans. • Can be operated again and again without change. • Will have all pans working a high "duty". That is, spending most of their time actually boiling material rather than sitting empty. • Will stagger the dropping of strike pans to enable good use to be made of the receivers, thus allowing a smooth rate of massecuite flow to the fugals. Also, it assists the operation of the steam boilers. This is because several pans will not start or stop at the same time. • Have the flexibility to change the A/B massecuite type to respond to different purity loadings/ A molasses levels.	
2.1.7	operating requirements and parameters and corrective action required where operation is outside specified operating parameters *factors that affect throughput and recovery, including the relationship between sugar pol and throughput; the balance between A, B and C pans and the effect of cane quality	Operating requirements and parameters	Set points, parameters, throughput	Deviation outside of set point parameters and cause and recommended procedures for rectification	DCS photos, set point photos	DCS set points. High and low values. Control mechanisms. Visual checks that set point are being achieved. Massecuite Condition on Dropping/Discharge One aim of the pan stage is to maximise the crystal content of the massecuite. Massecuite should contain maximum crystal content before it is dropped to the receiver. At the same time, the material must not become too viscous to transfer and fugal. In addition, the maximum possible amount of water should have been boiled off from massecuite within time and pan equipment limitations. Low crystal content and evaporation of water in one step of the pan stage process will increase the load on the next stage. If the next stage cannot cope with the increased load, then pan stage throughput will decrease.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
	and boiling formula						
2.1.8	* cleaned pans according to schedule or as indicated by equipment monitoring	DCS screen shot of pan cleaning mode	Check of clean prior to start of next cycle		Viewing windows before and after a clean show a good indication of the effectiveness of a clean	Pan Cleaning Systems and Procedures Juice becomes more and more concentrated during boiling. As the concentration increases, various materials can come out of solution. This material becomes deposited on the inside of the calandria tubes. Over a period of time, these deposits of scale can build up. Eventually this build up can slow down heat transfer. This in turn can slow pan throughput. Scale build up can often be controlled by steaming out the pan after each strike. If additional cleaning is required, pans can be cleaned by using them to boil water. Some factories do this routinely, perhaps once a week. Other factories boil water only when additional cleaning is required. Boiling dilute acid in a pan can be used to clean heavy scale build up.	
2.1.9	*added process additives as required by pan performance	Types of additives and photos of them			Anti-foaming chemicals, surface tension chemicals; usage, when, amounts. Shots through viewing window of foaming. Show this and DCS screen as to indications as to what factors lead to the addition plus foaming through the viewing window	Boiling Aid Boiling aids are chemicals sometimes added to low grade pans. These chemicals are used when the quality of the material entering the pan stage is poor. Poor quality material leads to increased viscosity of the massecuite. The addition of boiling aid can improve boiling and crystallization. The boiling massecuite is made less viscous or more fluid. Pan circulation is increased leading to decreased pan cycle time. Foaming in which pans and investigate causes and solutions.	
2.1.10	inspection or test points (control points) in the process and the related procedures and recording requirements the purpose and location of sensors and related feedback instrumentation *factors that affect flow of massecuite through the system	Significance and method of monitoring control points within the process Control points refer to those key points in a work process that must be monitored and controlled.	Control points v's set points		DCS photos, set point photos	Maintaining required levels, brix, conductivity in the pan cycle operations Factors that can affect pan stage throughput and efficiency. Material Densities Low density syrup and molasses slow down the throughput of a pan, since they contain relatively more water. This has the general effect of slowing down the overall throughput of the pan stage. Vacuum The highest vacuum or lowest absolute pressure gives the lowest boiling temperature. This is because it is easier for the gas bubbles to form under a higher vacuum. However, if the water is boiled off too fast, there will be a risk of fine grain formation. This is because the supersaturation levels become too high. A lower vacuum will mean a higher boiling temperature. The higher temperature will mean that the crystals will grow faster, but there is an increase in the colour formation and sugar loss. This is only if the degree of supersaturation can be maintained. The faster growth will be possible because the sugar molecules have greater mobility at higher temperatures. The degree of supersaturation drives the growth of crystals. However, it is the temperature which determines the rate at which the crystals will grow.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
						If the pan is boiled at high temperature, the crystals will grow quickly. However, the rate at which water can be boiled off is usually slower. For this reason, supersaturation will not be maintained. If the massecuite is boiled at too high a temperature, deterioration of the sugar may occur. The appropriate vacuum setting depends on: • The effect of vacuum on boiling temperature. • The requirement for injection water of other parts of the factory. Higher vacuum conditions require more injection water. If little injection water is available, it might be more important that vacuum be maintained on the evaporator rather than the pan stage. A decrease in vacuum will usually reduce the throughput in a pan. This in turn reduces the throughput of the pan stage. Steam Flow Low availability of steam flow reduces the evaporation rate. As a result, this increases pan boiling time and causes an overall reduction in pan stage throughput. Slower at the start when limited surface area available for crystallisation, increasing to full flow at 65% As a guide 20t/h max per 100t pan. Pan Feeding System and Control Syrup, molasses and water are fed into a pan under the control of measurements made by the conductivity probes. Pan stage efficiency will improve with accurate feed control to individual pans. If the pan feed system is not operating correctly, the conductivity may deviate from the set point. Also, supersaturation may become too high or too low. If the supersaturation is too high, false grain may appear. The false grain will either have to be removed or the lower sugar quality accepted. Removing the false grain will reduce (or) the higher possible throughput. If the supersaturation is too low, the rate of crystal growth will be reduced. False grain removal from a pan. Addition of water to reduce supersaturation to unsaturated so crystals dissolve or other methods that are used.	
2.1.11	Sampling schedule and procedures	• SUG202A Collect and prepare samples • SUG213A Perform standard tests on a cane sample • FDFOP2030A Operate a process control interface.	Need to look at what is relevant from these documents		Examples of scheduling, simplified as to what an operator would use or record Sampling from pans, microscope analysis, feel, conductivity	Accurate measurements of the properties of pan stage products are essential, for efficient pan stage operations. These measurements are used to adjust the operation of the pan stage, thus ensuring that quality and throughput are maintained. The measurements of the properties of the pan stage products are done by the factory laboratory. The laboratory analyses samples of pan products and records the results. These laboratory results are only accurate if the samples analysed are a true representation of the material being processed. This means that samples should be the same as the average composition of the material being sampled. There are three important factors to be considered when taking samples. These are: • The size of the sample	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
						• How often the samples are taken • The sampling method Typical Sampling Procedure • Get the sampler container. Ensure that it is the correct container and that it is clean. • Take the sample from the sampling point. Some factories may have any of the following sampling procedures: Continuous samplers, Snap samples and Composite samples. Store the sample. Each factory will have specific sampling locations for syrup, massecuites and molasses (A and B). These sampling locations and your factory's sampling procedure should be known. At some factories, the sampling of massecuite is performed at the fugal station. It is vital that good samples be obtained. This ensures that decisions about factory operations are based on accurate information. The full sampling procedure should be always be followed. This is to ensure that samples obtained are a true indication of the product stream. The operator will also take samples from the pans both batch and continuous plus use the data from the DCS. Sampling from pans, microscope analysis, feel, conductivity	
2.1.12	the effects of massecuite quality on operations the effect of massecuite quality on fugal operation the flow of the Pans process and the effect of product output on downstream processes	Crystal size, impurities, heavy up, temperatures, HG, LG Molasses and purities. What goes round comes round Communication	Reference to pan boiling for fugal operators video Pans Fugals interconnections and why each is so important to the good work and throughput of the factory	Controls that the operator can and cannot change	Photos of key control applications Fugals, Purity of A and B mol	significance and method of monitoring control points within the process Conductivity/resistance measures throughout pan cycles What can change the conductivity setpoints? Massecuite should contain maximum crystal content before it is dropped to the receiver. At the same time, the material must not become too viscous to transfer and fugal.	
2.1.13	contamination /food safety risks associated with the process and related control measures	Food grade packaging SS	Food grade and basic requirements for operational staff at pans		Condenser, Tori well, Condong NSW/Bundaberg food packing plant	If there is sugar in the vapour, the sugar will be lost in the condenser water where it will cause pollution. Constant monitoring of condensates for contamination by sugar is extremely important.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
	relevant to the Pans process environmental and waste handling requirements and procedures for operating a pan station. environmental issues and controls waste handling requirements and procedures						
2.1.14	work health and safety hazards and controls relevant to the Pans process following relevant work health and safety procedures. OHS hazards and controls	Material Safety Data Sheets(MSDS) where appropriate (see Evaporator cleaning course E04)	Any chemicals used in cleaning	SDS relevant titles only as data can change Identification of various types of Hazards What is the definition of a hazard	MSDS photo with relevant title but blurred information	Material Safety Data Sheets where appropriate Additives to Pans process Caustic, EDTA, Acid	
2.1.15	Work is carried out in accordance with company policies and procedures, licensing requirements, manufacturer's recommendations, and legislative requirements, codes of practice and industrial	SOP's	Check any related mill industry policies, awards, codes of practices that are specific to Pans operations	Look for any key points	Doc of relevant information	Industry related award and policy. SOP's	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
	awards and agreements.						
2.2.1	2.2 Control points are monitored to confirm performance is maintained within specification operating requirements and parameters significance and method of monitoring control points within the process	Monitor the process and equipment operation to maintain the process within the required parameters (Brix)	Set points, parameters, throughput	Deviation outside of set point parameters and cause and recommended procedures for rectification	DCS photos, set point photos	Syrup, A mol, B mol, C mol quality and quantity available Pre checks visual, DCS, Safe guards in place, communication with pans/Shift supervisor and other operators. Checking of shift log Walk past all equipment at start of shift/ start up Handover at start of shift	
2.3.1	2.3 C sugar and C molasses meet specification *prepared magma and grain for high/low grade seed production	C Mol purity		Seed pan	C sugar target size, growth rate, supersaturation, graining conditions, Purity, brix, crystal content, crystal numbers	C sugar properties required for good fugaling through continuous fugals used at the LG Remelt. C molasses pol, and preparation for storage and transport When too much C sugar is produced or it is not of a high enough standard, it is melted in a magma remelt tank. This is then recycled to the syrup tank. The remelted magma should be of a similar density to the syrup. In other words, a similar amount of sugar dissolved per unit volume of the solution. If the remelt is too light, the additional water will have to be evaporated by the pan. This will cause a slowdown in production.	
2.4.1	2.4 Equipment is monitored to confirm operating condition significance and method of monitoring control points within the process				What is the operator doing to ensure the correct procedures are taking place in each pan during a cycle and schedule. Operator inspecting pans through viewing windows	Many pan stage procedures are controlled automatically. However, it is important to know the steps that occur during the following procedures. Failure to follow factory procedures can result in things like: • Loss of grain which will then have to be re- crystallized. This will reduce the effective capacity of the pan stage. • Spillage of product to the factory floor, requiring product to be recycled and resulting in loss of throughput. • Excess fine grain resulting in fugalling difficulties and low quality sugar. • Loss of product to the injection water system. • Damage to vacuum pumps. Equipment failure in a dangerous manner may result in loss of production and replace/repair costs. Situations where knowledge of the procedures might be helpful:	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
						• If the automatic system fails and it has to be operated manually. • To monitor the automatic system to make sure that it is operating correctly. Note: Some factories refer to syrup as liquor and A and B molasses as A and B syrup respectively.	
2.5.1	2.5 Out-of-specification process and equipment performance is identified, rectified and/or reported *common causes of variation, and corrective action *taken corrective action in response to typical operating faults and product and process non-Conformance report and/or record corrective action as required	Take corrective action in response to out-of-specification results	Doc and flow chart	Various out-of-spec process and performance described	Flow chart of what to do depending on the severity of the issue Noxious (Incondensable) Gas When vapour enters a calandria it contains quantities of gases which do not condense to a liquid at the temperature of the calandria. For example, air can also enter the system through leaks in the vessels or pipe work. Carbon dioxide and other gases can come from the boiling juice. When the vapour condenses, these gases do not. Hence the other names: incondensable or non-condensable gases for noxious gases. Because these noxious gases do not condense and leave the calandria in the liquid condensate, they can accumulate inside the calandria and form a blanket around part of the tubes. This blanket of incondensable gas stops steam/vapour from getting to the outside of the tubes and so the rate of heat transfer decreases. The heat transfer rate is lowered because the heat must be transferred across the gas film, which is not good conductor of heat, before the heating steam/vapour gets to the outside of the tubes and be transferred to the juice inside the tubes.	The purity of the syrup supplied from the evaporator to the pan stage has an influence on boiling control. Higher purity material is easier to boil because the syrup circulates better, is less viscous and boils at a higher vacuum (lower absolute pressure) and a lower temperature. Lower purity material may be boiled at a smaller vacuum (higher absolute pressure) to aid circulation. The lower vacuum means that the boiling temperature will be higher. The higher temperature will reduce the viscosity of the liquid (make it thinner or runnier) so circulation will be easier. Poor syrup quality also means that the syrup boils at a lower conductivity and that crystallisation and boiling are slower. Usually there is a need to boil-on with water. Fresh syrup is brighter and has a lustre while stale syrup is darker and dull. Low density (low brix) syrup slows down pan throughput because it requires the pans to boil off more water. If pan throughput is reduced, the syrup tank might fill up (a liquor up) and it will be necessary for the effets to slow down. The ESJ tank might then fill up so the extraction station will have to slow down. Because the factory has slowed down, less cane is required so harvesting and transport of the cane need to be reduced as well. The entire system can be slowed if the syrup supplied to the pans is too light. Syrup feed to the pans should be as close as possible to a state of supersaturation so that pan throughput is maximised. That is, the syrup should have as high a brix as possible without actual crystals forming. If there are crystals in the syrup, there is a negative effect on the pan stage. The average size and size distribution of the crystal sugar produced by the pans will be worse.	
2.6.1	2.6 The workplace meets housekeeping standards The work area is maintained according to housekeeping standards	Housekeeping standards and procedures Confirming that housekeeping standards are met Maintain work area to meet housekeeping standards	Control area or room,	Neat, tidy, stocked with required equipment, no clutter from personal items from shift to shift	Pictures of the good the bad and the ugly	Control room and general set up and organisation	
3 Handover	3.1 Workplace records are maintained in		Doc explaining the importance of changeover log	Time, what happened in lead up to issue, issue, who contacted, follow up, current situation, further monitoring	Pictures or power points of operator/shift supervisor/electrician	Recording of information during shift, Time, what happened in lead up to issue, issue, who contacted, follow up, current situation, further monitoring. Legibility, clear concise information	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
the pans station *3.1.1*	accordance with workplace procedures correctly recorded process and production information.				etc discussing an issue and log book data recording		
3.2.1	3.2 Handover is carried out according to workplace procedure conducted shift changeover procedure demonstrate shift handover procedure				Discussion between 2 or more operators in control room, no faces to be shown	It may take several hours from when a batch pan is started until the massecuite is dropped. A pan might be started on one shift and dropped during the next shift. Pans are not necessarily started and dropped during the one shift. Therefore, information must be passed on to the next shift. Attention to accurate record keeping and communication is essential. It assists in the safe and efficient operation of the pan stage. Communication Flows There are four basic communication flows that are required for effective pan stage communication: Internal pan stage communications - Within the one shift. From one shift to the next shift. Communication outgoing from pan stage To other stages, for example the fugals or evaporators. To supervisors to report process problems and situation reports. Communication coming into the pan stage From other stages. For example, from the evaporators regarding the syrup supply. From supervisors to check on status or advise of some problem or change. General, factory wide communication To all factory personnel, for example to relay factory stops and starts. Communication flows and communication procedures vary from factory to factory. There are several types of communication commonly used on pan stages. The importance of clear, accurate communication at the right time is very important. It is essential for safe and efficient factory operation.	
3.2.2	typical equipment faults and related causes, including signs and symptoms of faulty equipment and early warning signs of potential problems	Control station throughput			Table	Faulty equipment. Design table with what can go wrong with equipment. Valves, pumps, holes in pans, conductivity probe, stirrers, …….	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
3.2.3	procedures and responsibility for reporting production and performance information procedures and responsibility for reporting problems	Record workplace information	The importance of the log and the records	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	Typical log entries	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	
3.2.4	responding to and/or reporting equipment failure within level of responsibility completing workplace records as required procedures and responsibility for reporting problems	Procedures and responsibility for reporting problems	The importance of the log and the records	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	Typical log entries	Log books both manual and electronic, type of information required eg time, issue, who reported to, actions, follow up, rectification	
3.2.5	Maintenance requirements are identified and reported according to workplace reporting requirements record workplace information	Record workplace information	Questioning and understanding that handover information has been transmitted and received	Checking by both the person finishing a shift and the new operator that both are satisfied that all relevant information has been given and understood	Video of discussion at handover showing both log book and issue	Questioning by new operator of written and verbal instructions to check complete understanding of all instructions	
3.2.6		Recording requirements and procedures	Questioning and understanding that handover information has been transmitted and received	Checking by both the person finishing a shift and the new operator that both are satisfied that all relevant information has been given and understood	Video of discussion at handover showing both log book and issue	Questioning by new operator of written and verbal instructions to check complete understanding of all instructions	
3.3.1	3.3 Pans station operators are aware of system and	Monitor the process and equipment operation to maintain the			Current and expected short term conditions and supplies of liquor, A mol, B mol, Magma	monitor the process and equipment operation to maintain the process within the required parameters including monitoring:	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
	related equipment status at completion of handover techniques used to monitor the Pans process, including inspecting, measuring and testing as required by the process	process within the required parameters					
3.3.2	monitoring supply and flow of materials to and from the Pans process	Manufacturer's specifications				Manufactures recommendations v's SOP's	
4 Shut down the pans station *4.1.1*	4.1 The appropriate shut down procedure is identified	The circuit flow of this process and relationship to related processes	Flow diagram and why order of shut down is important. Auto and manual	Order of shut down DCS and visual inspections	Pans operations re different types of shut downs	Shut down sequence Requirements of both operational and long term shut down conditions to ensure the equipment is left in a safe state for the period of the shutdown and to minimise any delays in future start up If there is going to be a long stop, as much material as possible is boiled out. This is to avoid having to store material. If the stop is only brief, stirred vessels are left running. These are the magma tank, crystallizers, receivers and magma and seed vessels. If stopped, the material in the vessels will harden making restart more difficult. (Dependant on the duration of the stoppage and reason for it)	
4.1.2	Requirements when shutting down full Pans operations containing hot massecuite					Requirements when shutting down full Pans operations containing hot massecuite Pan Shut Down Procedure (Batch Pan) On occasion, a pan may be shut down with some material still in it. This may occur in emergency situations. It may also occur when it is necessary to avoid boiling out the pan stage because there is little reserve bagasse for boiler fuel. Shutting down a pan which still contains material also allows for quicker pan stage start up. Pans are usually not shut down if they are full or nearly full. This is because it is difficult to restart circulation. Step 1. Shut off the steam to the vessel, but leave the vacuum on if possible. This will cool the pan which will improve the storage properties of the massecuite, thus avoiding possible problems during start up. Step 2. If a pan with material in it has to be shut down,	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
						the content level should ideally not be more than 0.6 metres above the calandria. (difficulties if above this level and will require a mill specific solution) It is very difficult to start up a pan containing material without product overflowing into the condenser. The massecuite is concentrated so that it is heavier than the normal working weight. The feed ring and the bottom of the pan are lubricated with B molasses. This will ensure that the feed line will not become blocked with crystal sugar. Step 3. The feed valve and the riser valves are shut, leaving the feed ring full of molasses. The vacuum is kept up for at least half an hour after the steam is shut off. This is to cool the pan. Step 4. After the pan has cooled, turn off the injection water. Step 5. Turn off the vacuum pump. Step 6. All empty pans require a steam out. They are then boiled with water which is normally drained to the clarifiers. If necessary, some pans are boiled with caustic or acid, to further clean the pans. The doors are left open on all empty pans. This is to drain any liquid that may enter the pan from leaking valves. Step 7. Open the vacuum breaker and stop the pan stirrer, if fitted. Step 8. Check all valves and doors to ensure that no material can leak from the pan. Also, check that other material cannot flow into the pan. Step 9. The cutting main drain valve is left open and the line flushed thoroughly from all ends. The flushings are sent to a storage tank. Step 10. It may be standard practice to chock particular doors. This is due to the possibility of doors or valves opening when the automatic control system is shut down. Step 11. All syrup and molasses valves are checked to ensure they are shut. All pumps should be shut off. Step 12. Each receiver is lubricated with molasses. This is to prevent the material from going solid. Pan Shut Down Procedure (Continuous Pan) It is more likely for a continuous pan to be shut down with material in it, than a batch pan. This is because of the different nature of their operations. The procedure to shut down a continuous pan with material in it can be done in two ways. It depends on whether the stop is going to be relatively short or longer; longer being more than 4 hours. Short Stop If the stop is planned and brief, the pan should be slowed rather than stopped. Step 1 Reduce Steam Flow to the minimum needed for adequate circulation. Step 2. The cells should be fed on water. Step 3. The seed pump supplying feed to the first cell should be placed in recycle mode.	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
						Long Stop If a longer stop is planned, efforts should be made to lower the level of massecuite (if possible). This is to avoid start-up problems. Step 1. Slow the addition of the seed to the minimum. Step 2. Put all cells on water feed for ten minutes or so. Step 3. Shut off all feed. Step 4. Shut off the steam. Step 5. Leave vacuum on for about half an hour. This is to cool the pan. Then shut vacuum off. Step 6. Stop the seed. Step 7. Flush seed and massecuite lines thoroughly.	
4.1.3	locating emergency stop functions on equipment shut down equipment in response to an emergency situation	Shut down equipment in response to an emergency situation	Types of emergencies and where and what operator can do	Life, fire, overfilling, hot water	Stop options available depending on the situation brownouts/blackout	Shut down equipment in response to an emergency situation Impact of Blackouts/Brownouts A complete blackout means that all electrical power has been lost. As a result, all electrically driven equipment will have stopped. This equipment includes: • Injection water, vacuum, condensate and hot water supply pumps. • Compressed air and hydraulic supply units. • Mixers, receivers and pan stirrers. If the blackout is only short, all the above equipment will need to be restarted. This needs to be done, before the pans can be brought back into operation. If the blackout is a long one, the isolation valves on the pans need to be closed. This is to avoid processing problems. Compressed air or hydraulic powered valves may need to be manually closed. When power has been restored, all those valves will need to be manually reopened. Impact of Breakdowns A factory breakdown will probably result in the preparation, milling and evaporation stations being shut down. The power generation station will probably be left running. However, there will be less exhaust steam available. If fuel reserves are low, management may be reluctant to burn fuel oil to provide HP steam make up. Syrup supply from the evaporators will be interrupted. Pans may need to be rescheduled. This is so as to make best use of the available steam, syrup and A and B molasses supply. Some pans may have to be idled for long periods. Others pans may be dropped at a lower level than usual. This is to decrease steam demand. Loss of Injection Water Loss of injection water will result in rapid drop in vacuum. The pans will boil at a high temperature in this low vacuum. Steam valves will need to be closed as quickly as possible. This is to avoid sugar degradation. The vacuum pump may need to be isolated to prevent it from overheating. Feed systems may also need to be isolated, stopping feed to the pan. Discuss how to vacuum up when the pan is full.	
4.2.1	4.2 The pans station is shut	Shut down sequences	Doc + Photos		(a) Quick shutdown.	SOP's of shut down and visual inspections of proceedings	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
	down according to workplace procedures shutdown requirements: *shutdown sequence, including massecuite pumps and stock management Loss of injection water will result in rapid drop in vacuum. The pans will boil at a high temperature in this low vacuum. Steam valves will need to be closed as quickly as possible. This is to avoid sugar degradation. The vacuum pump may need to be isolated to prevent it from overheating. Feed systems may also need to be isolated, stopping feed to the pan.				(b) Full shutdown	The steps in the pan's shutdown process is decided by how the pans are to restart is to happen at conclusion of the cleaning process. If this is a cleaning stop only and normal operation is to resume as soon as possible after the clean, a quick shutdown may be implemented. However, if an extended stoppage is expected at the conclusion of the pan clean	
4.2.2	The Pans operation station is prepared for storage in	Requirements of both operational and long term shut down conditions to ensure the equipment is left in	Doc + Photos	Checks required prior to maintenance season schedule	Basic cleaning/shutdown cleaning at end of season	Shut down and storage Pans operations Pans boiled out with water. Receivers/coolers washed with water	

Element / (*code*)	Performance Criteria	Required knowledge	Requirements for LMS	Key points	Photos/Videos/Diagrams	Course Outline	
	shut down mode preparing equipment for cleaning	a safe state for the period of the shutdown and to minimise any delays in future start up					
4.3.1	4.3 The pans station is prepared for storage in shut down mode shutdown requirements: requirements of operational and long-term shutdowns requirements of both operational and long term shut down conditions to ensure the equipment is left in a safe state for the period of the shutdown and to minimise any delays in future start up	Recording requirements and procedures	Mill logs, verbal communication	Importance of standard procedure on delivery of information at change over via log books, verbally and visually	Mill commonly used procedure in a flow chart	DCS displays, visual checks, communication with relevant staff	
4.4.1	4.4 Maintenance requirements are identified and reported recording requirements and procedures	Recording requirements and procedures	Importance of the log and the records	Issues and maintenance program identified in consultation with appropriate staff from seasons log book issues and schedules	Maintenance form	Checks of all equipment and documentation of required maintenance	

12.7 Appendix 7 – Current course enrolments by company

TABLE 12.2 AUSTRALIAN SUGAR INDUSTRY GENERAL (NON COMPANY SPECIFIC) COURSE ENROLMENTS

COURSE	NUMBER OF CURRENT ENROLMENTS
CO3 - Operate a juice clarification process - SMIO - V2	14
L01 v1.20 TOTrain	45
Operate a Mud Filtration Process - SMIO - V2	1
P03 - Operate a pan station -FBPSUG2013	2
C01 SOTrain - Clarification and Mud Filtration	10
Chemically Clean Equipment, Evaporators - SMIO	9
Chemically Clean Equipment, Evaporators - SMIO - V2	1
E01 SOTrain - Juice Heating and Evaporation	9
F03 - Low Grade Fugals- SMIO	18
G02 SOTrain - Introduction to Sugar Factory Processing	24
H01 SOTrain - Fugalling and Sugar Drying	3
H02 SOTrain - Fugalling and Sugar Drying - Course	13
H03 High Grade Fugals and Sugar Drying - SMIO	20
M01 SOTrain - Extraction	8
O03-Cooling Crystallisers - SMIO	16
Operate a Crystallisers Process Station - SMIO - V2	1
Operate a Mud Filtration Process - SMIO	8
Operate an Evaporation Process - SMIO	10
Operate and Monitor an Evaporation Process - SMIO - V2	1
P01 SOTrain - Pan Boiling	8
S01 SOTrain - Steam and Power Generation	7
G05 SRI videos	28
SRI Videos	1

TABLE 12.3 BUNDABERG SUGAR COURSE ENROLMENTS

COURSE	NUMBER OF CURRENT ENROLMENTS
Chemically Clean Equipment, Evaporators - SMIO	2
CO3 - Operate a juice clarification process - SMIO - V2	2
F03 - Low Grade Fugals- SMIO	2
H02 SOTrain - Fugalling and Sugar Drying - Course	20
H03 High Grade Fugals and Sugar Drying - SMIO	23
M01 SOTrain- Extraction - Basic	8
O03-Cooling Crystallisers - SMIO	2
Operate a Mud Filtration Process - SMIO	2
Operate an Evaporation Process - SMIO	2
P01 SOTrain- Pan Boiling - Basic	9
S01 SOTrain - Steam and Power Generation - Basic	8
SRI Videos	16
L01 v1.20 TOTrain	1
G02 SOTrain - Introduction to Sugar Factory Processing	12
Juice Heating and Evaporation - Basic	7
SOTrain - Clarification and Mud Filtration	7

TABLE 12.4 ROCKY POINT COURSE ENROLMENTS

COURSE	NUMBER OF CURRENT ENROLMENTS
Fugalling and Sugar Drying - Course	3
C01 SOTrain - Clarification and Mud Filtration	19
E01 SOTrain - Juice Heating and Evaporation - Basic	16
G05 SRI Videos	27
H01 SOTrain - Fugalling and Sugar Drying - Basic	11
M01 SOTrain - Extraction - Basic	20
P01 SOTrain - Pan Boiling - Basic	13
S01 SOTrain - Steam and Power Generation - Basic	14
Chemically Clean Equipment, Evaporators - SMIO	2
Operate a Mud Filtration Process - SMIO	1
Operate an Evaporation Process - SMIO	2
C03-Operate a juice clarification process - SMIO - V2	2
Chemically Clean Equipment, Evaporators - SMIO - V2	1
F03 - Low Grade Fugals- SMIO	3
G02 SOTrain - Introduction to Sugar Factory Processing	27
H02 SOTrain - Fugalling and Sugar Drying - Course	3
H03 High Grade Fugals and Sugar Drying - SMIO	3
O03-Cooling Crystallisers - SMIO	4
Operate a Crystallisers Process Station - SMIO - V2	1
Operate a Mud Filtration Process - SMIO - V2	1
Operate and Monitor an Evaporation Process - SMIO - V2	1

TABLE 12.5 ISIS SUGAR COURSE ENROLMENTS

COURSE	NUMBER OF CURRENT ENROLMENTS
CO3 - Operate a juice clarification process - SMIO - V2	3
C01 SOTrain - Clarification and Mud Filtration - Basic 2018	11
Chemically Clean Equipment, Evaporators - SMIO	1
E01 SOTrain - Juice Heating and Evaporation	9
F03 - Low Grade Fugals- SMIO	29
G02 SOTrain - Introduction to Sugar Factory Processing	28
H02 SOTrain - Fugalling and Sugar Drying - Course	9
H03 High Grade Fugals and Sugar Drying - SMIO	29
L01 v1.20 TOTrain	17
M01 SOTrain - Extraction	7
O03-Cooling Crystallisers - SMIO	27
Operate a Mud Filtration Process - SMIO	1
Operate an Evaporation Process - SMIO	1
P01 SOTrain - Pan Boiling	6
S01 SOTrain - Steam and Power Generation	6
SRI Videos	29

TABLE 12.6 FAR NORTHERN MILLING COURSE ENROLMENTS

COURSE	NUMBER OF CURRENT ENROLMENTS
C01 SOTrain - Clarification and Mud Filtration - Basic	17
G05 SRI Videos	37
O03-Cooling Crystallisers - SMIO	18
Chemically Clean Equipment, Evaporators - SMIO	11
CO3 - Operate a juice clarification process - SMIO - V2	15
E01 SOTrain - Juice Heating and Evaporation - Basic	17
F03 - Low Grade Fugals- SMIO	15
G02 SOTrain - Introduction to Sugar Factory Processing - Course	31
H02 SOTrain - Fugalling and Sugar Drying - Course	16
H03 High Grade Fugals and Sugar Drying - SMIO	16
M01 SOTrain - Extraction	23
Operate a Mud Filtration Process - SMIO	11
Operate an Evaporation Process - SMIO	11
P01 SOTrain - Pan Boiling	18
S01 SOTrain - Steam and Power Generation	19
L01 v1.20 TOTrain	5

TABLE 12.7 MSF COURSE ENROLMENTS

COURSE	NUMBER OF CURRENT ENROLMENTS
L01 v1.20 TOTrain	5
Chemically Clean Equipment, Evaporators - SMIO	8
Clarification and Mud Filtration - Operator	8
CO3 - Operate a juice clarification process - SMIO - V2	8
E01 SOTrain - Juice Heating and Evaporation - Basic	9
F03 - Low Grade Fugals- SMIO	9
Fugalling and Sugar Drying	6
G02 SOTrain - Introduction to Sugar Factory Processing	15
H02 SOTrain - Fugalling and Sugar Drying - Course	7
H03 High Grade Fugals and Sugar Drying - SMIO	12
O03 - Cooling Crystallisers - SMIO	8
Operate a Mud Filtration Process - SMIO	7
Operate an Evaporation Process - SMIO	8
M01 SOTrain-Extraction-Basic	7
Videos	13
P01 SOTrain - Pan Boiling - Basic	7
S01 SOTrain - Steam and Power Generation - Basic	8

TABLE 12.8 MACKAY SUGAR COURSE ENROLMENTS

COURSE	NUMBER OF CURRENT ENROLMENTS
Clarification and Mud Filtration - Basic	21
SRI Videos	66
ATO Car / Utility	3
ATO Mill Roller Arcing	39
L01 v1.20 TOTrain	3
MS Word 2019	25
Adobe Acrobat DC Pro Advanced	5
Adobe Acrobat DC Pro Beginner	5
C03-Operate a juice clarification process - SMIO V2	22
Chemically Clean Equipment, Evaporators - SMIO	10
Contractor Online Induction (v1.1)	1751
Contractor Online Induction (v1.2)	9
Driver Assistant Assessments	4
Employee Online Induction (v1.1)	578
Employee Online Induction (v1.2)	1
EO1 SOTrain: Juice Heating and Evaporation Rev. 1	22
Excel 2019 Advanced	6
Excel 2019 for Beginners	46
F03 - Low Grade Fugals- SMIO	35
Fire Safety (MSL-LMS-FS-01) v1.1	562
G02 SOTrain - Introduction to Sugar Factory Processing	71
H02 SOTrain - Fugalling and Sugar Drying - Course	16
H03 High Grade Fugals and Sugar Drying - SMIO	54
Human Resources Induction (v1.1)	71
Level up! People Management	2
M01 SOTrain - Extraction	12
Microsoft Teams	13
MS Access 2016 Beginners	7
MS Project 2013 for Beginners	2
MS Project 2019 for Beginners	13
O03-Cooling Crystallisers - SMIO	24
Operate a Mud Filtration Process - SMIO	11
Operate an Evaporation Process - SMIO	11
Operate and Monitor an Evaporation Process - SMIO - V2	1
P01 SOTrain - Pan Boiling	16
Power BI	10
Project Management (Short Course - Microlearn)	2
Resilience in the workplace	3
S01 SOTrain - Steam and Power Generation	17
ATO EWP <11m Operator / Spotter	4

COURSE	NUMBER OF CURRENT ENROLMENTS
ATO Mill Roller Arcing v1.1	4
Effective OHS Committees and Meetings	8
Workplace Communication Skills	9
PMP Certification	5
Safe Use of Oxy & Acetylene Equipment	8

TABLE 12.9 SRA COURSE ENROLMENTS

COURSE	NUMBER OF CURRENT ENROLMENTS
SRI Videos	1

TABLE 12.10 SUNSHINE SUGAR COURSE ENROLMENTS

COURSE	NUMBER OF CURRENT ENROLMENTS
CO3 - Operate a juice clarification process - SMIO - V2	6
Chemically Clean Equipment, Evaporators - SMIO	5
F03 - Low Grade Fugals- SMIO	9
H02 SOTrain - Fugalling and Sugar Drying - Course	12
H03 High Grade Fugals and Sugar Drying - SMIO	28
O03-Cooling Crystallisers - SMIO	8
Operate a Mud Filtration Process - SMIO	5
Operate a pan station -FBPSUG2013	2
Operate an Evaporation Process - SMIO	5
SRI Videos	31
Clarification and Mud Filtration	25
Extraction	28
Fugalling and Sugar Drying	23
Introduction to Sugar Factory Processing	30
Juice Heating and Evaporation	25
Pan Boiling	24
Steam and Power Generation	26

TABLE 12.11 TULLY SUGAR COURSE ENROLMENTS

COURSE	NUMBER OF CURRENT ENROLMENTS
C01 SOTrain - Clarification and Mud Filtration	12
E01 SOTrain - Juice Heating and Evaporation - Basic	10
G02 SOTrain - Introduction to Sugar Factory Processing	13
P01 SOTrain - Pan Boiling - Basic	10
CO3 - Operate a juice clarification process - SMIO - V2	7
L01 v1.20 TOTrain	9
Chemically Clean Equipment, Evaporators - SMIO	2
F03 - Low Grade Fugals- SMIO	7
H02 SOTrain - Fugalling and Sugar Drying - Course	6
H03 High Grade Fugals and Sugar Drying - SMIO	19
M01 SOTrain - Extraction	7
O03-Cooling Crystallisers - SMIO	7
Operate a Mud Filtration Process - SMIO	2
Operate an Evaporation Process - SMIO	2
Tully SO1	11
SRI Videos	26
Contractor Induction	699

TABLE 12.12 WILMAR COURSE ENROLMENTS

COURSE	NUMBER OF CURRENT ENROLMENTS
CO3 - Operate a juice clarification process - SMIO - V2	54
L01 v1.20 TOTrain	14
C01 SOTrain - Clarification and Mud Filtration	85
Chemically Clean Equipment, Evaporators - SMIO	18
Chemically Clean Equipment, Evaporators - SMIO - V2	1
E01 SOTrain - Juice Heating and Evaporation	84
F03 - Low Grade Fugals- SMIO	72
G02 SOTrain - Introduction to Sugar Factory Processing	84
G05 SRI Videos	83
H01 - SOTrain - Fugalling and Sugar Drying	58
H02 SOTrain - Fugalling and Sugar Drying - Course	78
H03 High Grade Fugals and Sugar Drying - SMIO	78
M01 - SOTrain - Extraction	81
O03-Cooling Crystallisers - SMIO	69
Operate a Crystallisers Process Station - SMIO - V2	1
Operate a Mud Filtration Process - SMIO	19
Operate a Mud Filtration Process - SMIO - V2	1
Operate an Evaporation Process - SMIO	18
Operate and Monitor an Evaporation Process - SMIO - V2	1
P01 SOTrain - Pan Boiling	80
S01 SOTrain - Steam and Power Generation	79

13 SRA RESEARCH MISSIONS MANAGER'S RECOMMENDATION

(To be completed by the SRA Research Missions Manager, Research Investments)

Milestone Number			
Milestone Title	Final Report		
Final Report Due Date		Date submitted	
		Date of submission of revised version (if relevant)	
Date Reviewed		Date of review of revised version (if relevant)	
Reason for delay (if relevant)			
Milestone Payment			
Total Project Funding by SRA-RMS			
Project Objectives (Contracted)			
Success in achieving the objectives	☒ Completely Achieved ☐ Partially Achieved ☐ Not Achieved		

SRA Research Missions Manager's comments:

Project Outputs (brief version)

Activities to further develop, disseminate, commercialise or exploit the Project Outputs (after discussion with CI)

Recommendation: