# Report on Coal Seam Gas Scoping Study

for Manufacturing Skills Australia

Total Training and Performance Solutions

23rd December 2009

# Contents

# Executive Summary

CSG is a significant and fast growing sector. Providing a sufficient, competent workforce in a timely manner will be a challenge.

The sector covers all processes from an established well through to providing gas to a customer (via pipeline) or an LNG plant and may include operation of the LNG plant followed by loading of LNG into a tanker. The differences to traditional gas are concentrated in, but not limited to, the upstream end.

The development of five new units of competency and the importation of two additional existing units of competency are recommended for PMA08.

# Background

Coal Seam Gas (CSG) is a rapidly growing sector of the hydrocarbons industry with the offices currently centred in Brisbane. Members of the Hydrocarbons Assessor Network (HAN) who are also in the CSG sector commented that there were some potential gaps in the PMA08 Chemical, Hydrocarbons and Refining Training Package to service the CSG sector well. Manufacturing Skills Australia (MSA), the Industry Skills Council with coverage of hydrocarbons, responded by commissioning a scoping study to determine the fit of PMA08 with the needs of the CSG sector with a view to identifying and closing any gaps.

The development of CSG is also seeing a rapid expansion of Liquefied Natural Gas (LNG) operations. Many organisations that have not had a previous involvement with LNG are anticipating operating a LNG plant (or plants) in the near future which will use CSG as its feed. The operation may be direct or as part of a joint venture.

# Scope

The scope of this project is to investigate the fit of PMA08 with the needs of the CSG sector and report back to MSA.

There are other current MSA projects also dealing with changes to PMA08, but they are not included in the scope of this project.

# Methodology

An expert group was organised and held a workshop at the Origin Energy head office in Brisbane on 20th October 2009. The intention was to keep this initial workshop small to better facilitate a critical analysis. The expert group was drawn from organisations that were well down the path of CSG and the people invited had a technical knowledge of the CSG process and also of the relevant PMA08 units of competency.

The workshop itself used three different methodologies consecutively:

1. Process mapping – development of a flow sheet of the process and related processes from beginning to end (and so also defining the beginning, the end, and everything in between)

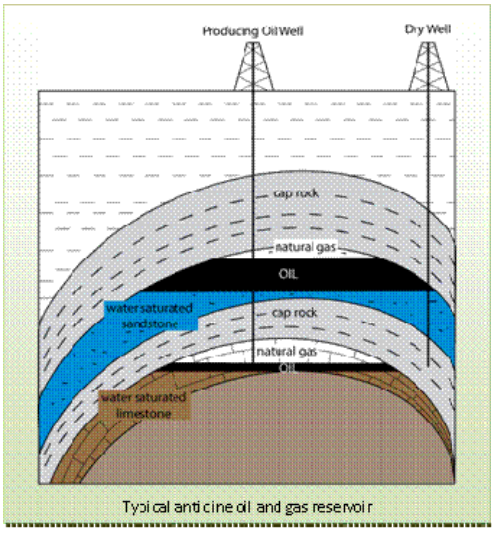
2. Modified CAJA[1] – mapping of existing units of competency to the process map and so identifying gaps

3. Modified DACUM[2] – generating data to allow for the required new units to be written

The results of this workshop were then written up and reported back to the expert group to check it was an accurate reflection of the workshop.

The report was then circulated more broadly to people in the CSG sector for comment and feedback.

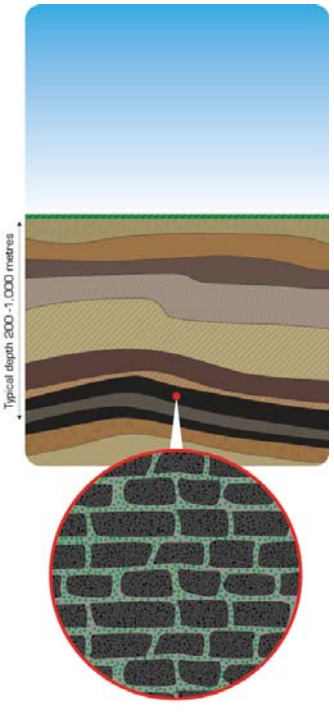
It is expected that following acceptance of this report by both the CSG industry and MSA that authorisation to develop the proposed new units of competency will be given.



Typical anticline oil and gas reservoir

## The geology (briefly)

Traditional hydrocarbons are formed by anaerobic microbial attack on prehistoric carbohydrates so forming a mixture of hydrocarbon compounds. These migrate through porous soil and rock until they become trapped in a reservoir. As the hydrocarbons are withdrawn (eg through a well) more water may seep in to maintain pressure on the hydrocarbon.




CSG is formed in/associated with coal seams and is adsorbed onto the surface of coal in the coal seam. Traditionally this has only been released when the coal was mined, so making the mining even more hazardous. Coal in a seam is not a continuous amorphous mass but is rather divided by a myriad of fine cracks called 'cleats' which are of sub-nanometre width. This network of cleats provides a high surface

[1] CAJA – Competency And Job Analysis – a technique developed by the TaPS team for identifying relevant existing units of competency for a job. See Australian Training Review, July 2000 No. 35, Building a skills wall, Dutneall R, Hummel K, pp14, 15

[2] DACUM – Developing A CUrriculuM – a technique developed by the Canadians for helping job incumbents to develop curriculum.

area for the CSG to be adsorbed onto. There is also water trapped in these cleats (apparently also formed in/associated with the coal seam), so causing a high enough pressure to keep the gas adsorbed. This pressure needs to be reduced in order for the CSG to desorb and so become available for extraction.

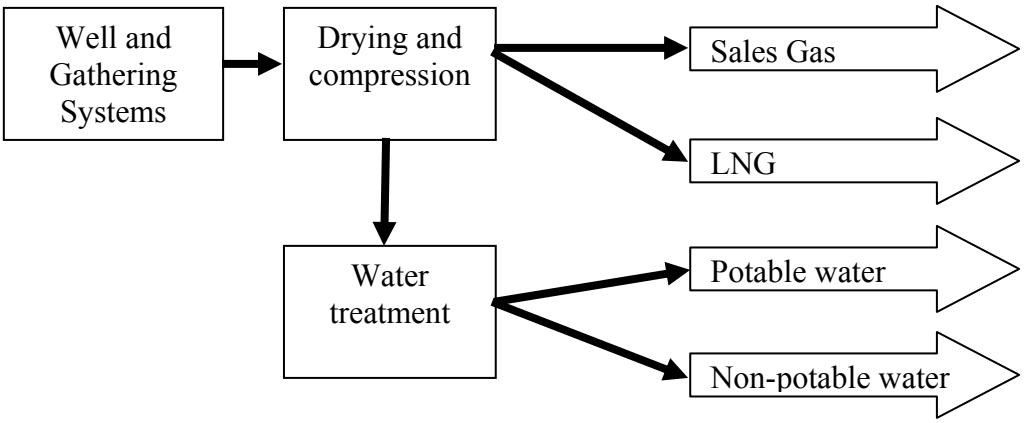
# The industry

## CSG boundaries

The CSG sector extracts gas from coal seams and processes it to sell as gas into the pipe grid and/or convert it to Liquefied Natural Gas (LNG) for export. This sector commences after a production well has been drilled, plant and equipment has been installed and this plant and equipment has been checked that it complies with specification. This may include some precommissioning of the plant and equipment, but not commissioning with hydrocarbons which is done by the CSG sector. This drilling, installation and precommissioning is typically done by contractors.

While organisations which own CSG operations may have a broader spread, the sector itself stops when the gas is delivered by pipeline to the city grid, a large consumer, or is loaded as LNG onto a tanker after being converted to LNG.

All operations between these boundaries are part of the CSG sector. See the file labelled CSG Process Flow Map for details of these processes (processes are tagged for identification purposes only). This is summarised in the diagram below.




Note that while the sector is about gas, the treatment and disposal of water is also vital, because if the water cannot be satisfactorily disposed of, there may be no operation (a licence to operate may be refused on environmental grounds). Given the fragile nature of natural water flows in Australia, the production of potable water, or water for irrigation, as a by-product can be very useful and important. Water treatment therefore is part of this sector.

Non-potable water may be disposed of by irrigation of salt tolerant species.

## Comparison of CSG with traditional gas

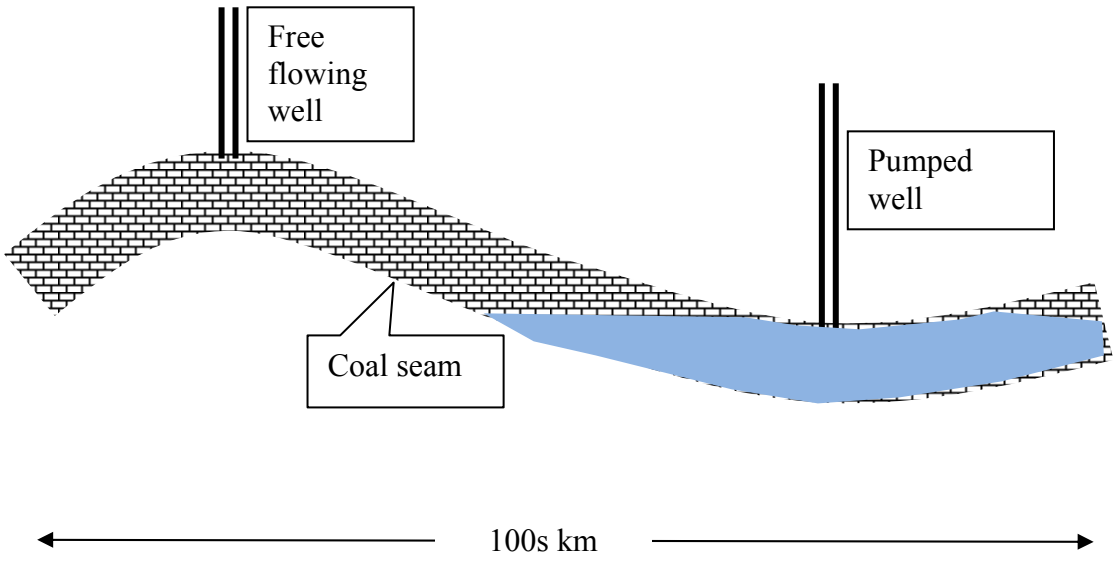
Both produce a gas which is predominantly methane ($CH_4$) as their final product. The consumer would not notice a difference.

Traditional gas produces gas from a well which taps a reservoir. It produces gas and some higher homologues such as ethane ($C_2$), propane ($C_3$), butane ($C_4$) and what is known as 'condensate' ($C_5^+$) which is a light liquid. Traditional gas is also often highly contaminated with $CO_2$ which needs to be removed. In the past this has not been a problem, but with the focus on a low carbon economy, high $CO_2$ wells may become problematic.[3]

CSG produces essentially pure $CH_4$, but it may be accompanied by vast quantities of water. Like most artesian water in Australia, this water is very salty with some salts being carbonates ($CaCO_3$, $MgCO_3$) and so it is also alkaline. The water generally requires treatment before release to the environment/ customer. There is virtually no $CO_2$ produced.

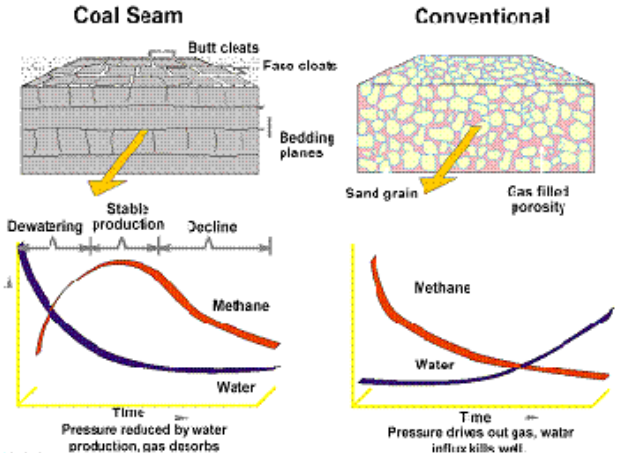
Traditional gas may have several hundred wells feeding a processing plant. The gas will frequently have sufficient pressure to leave the well under its own pressure. As wells get older this pressure decreases and may need to be augmented by pumping fluid (typically $CO_2$ or water) down into the reservoir, so increasing the pressure and forcing the gas out. So, traditional gas works under pressure.

CSG will have several thousand wells feeding a processing plant. Gas may flow from the coal seam under its own pressure, but equally may not flow until water which has saturated the cleats is first pumped out using a down hole pump of some type.




[3] Burning $CH_4$ as a fuel is a low carbon alternative to other burned fuels. This advantage is blunted if $CO_2$ needs to be vented while producing a low carbon fuel.

These down hole pumps need to be operated at a flow rate which balances the water recharge of the well from the coal seam so that the pump retains sufficient static head to operate efficiently and without damage. As water recharge slows, so should the pumps. It is possible to pump a well dry of water and it then becomes a 'free flowing' well. The CSG wells and gathering systems are kept under low pressure, preferably vacuum to encourage the gas to flow from the well. This is the main function of the screw compressor (tag F on the Process Flow Map)




In CSG, pumping water level down, so reducing the well pressure, allows/ increases the flow of gas. In traditional, increasing the pressure in the well increases the flow of gas.

At this stage it was felt that the existing units[4] which deal with LNG would be suitable for CSG based LNG also, although the technical difference of having no higher homologues in the CSG and its impact on the process was noted.

## Workforce issues

This is a rapidly expanding sector. Growth is currently limited by the ability of the gas grid to take any more gas. New developments such as gas fired power stations and particularly the export of LNG are expected to allow for a significant expansion. The sector are looking at adding in the order of 50 people per year per organisation (and there are several of them) into the foreseeable future. There is a CSG expected workforce eventually of 18 000[5] in Queensland, most of whom will be new to the industry.

This rate of expansion requires new operators to become competent at the basic level (monitor) in six to eight months and becoming 'fully fledged' operators within two to three years.

There is currently not the workforce to meet this demand. Queensland CSG companies are cooperating in the training and assessment of high school students in the PMA08 Certificate II. This requires them to spend some significant time on plant to gain competence. The availability of a parallel VET qualification which emphasised the theory and did not require plant based competency would ease this situation by providing a work ready, although not

[4] NOTE that a DACUM around Joule Thompson effect equipment was undertaken at the December 2009 HAN meeting using members as an expert group. The resulting unit has broader application than just CSG and so this is being run as a separate project. The draft unit is available for comment.
[5] 18 000 is the officially published statistic and not all in the industry agree with it.

competent, labour pool which should see competence develop more quickly. This should contribute to the supply for a competent workforce.

# The units of competency

## New units

The mapped units of competency are shown against the Process Flow Map in the file labelled 'CSG Mapped CAJA'. This shows all current and proposed units aligned to their respective processes. Many units of course apply to a range of processes and this is shown by the yellow bars spanning a range of processes. The list of all units is also shown as Appendix 2.

From this CAJA it was determined that the following additional five units are required. They have been given working codes for the purpose of this report and will be allocated proper codes when they are drafted. The proposed new units are:

- CSG200 Monitor wells and gathering systems
- CSG201 Monitor and operate compressors
- CSG300 Operate wells and gathering systems
- CSG400 Manage wells and gathering systems
- CSG401 Commission wells and gathering systems

This analysis concentrated on the technical units. The expert group agreed that it is unlikely that there will be specialist support units.

## Discussion of proposed new units

All of the proposed units above will be technical units (ie in Group 2 of PMA08). These were previously known as 'OPS' units in PMA02.

Similar units have been proposed at different levels. While this has been unusual in PMA, it is common in other Training Packages. It is thought to be appropriate for the CSG sector due to the relatively higher number of field operators compared to traditional hydrocarbons.

CSG300 will include the CSG200 competency within it. Some organisations therefore may choose to move their workforce directly to CSG300.

The field based small screw compressors (tag F on the Process Flow Map) are considered to be less complex to operate[6] than the compressors covered by the existing unit (PMAOPS304), so requiring another unit (CSG201). This

[6] NOTE this is not making comment about the technical sophistication of the compressor itself, simply the skill level needed to do the job.

conclusion was reached after some discussion, and analysis of what the possible new unit may contain, by the expert industry committee.

The relationship of the proposed new units CSG300 and CSG400 with existing units (such asPMAOPS321) will need to be checked as part of the development and validation process.

CSG401 has been proposed for the CSG sector only, but feedback has been received that it may be appropriate in a broader context. This will be considered as part of the development and review process.

### Additional units

It was also noted that two existing units from other Training Packages would be required to meet the needs of CSG. These units are:

- RIIENV201A Identify and assess environmental and heritage concerns
- NWP357B Monitor, operate and control reverse osmosis and nano filtration processes

### Packaging of the units

It is not expected that the requirements for the qualification will be changed by the creation of these new units (other than by having additional units to choose from). It is expected that:

- the list of mandatory units will remain the same
- the units provisionally coded:
  - CSG200 and CSG201 will be Group 2 units in the Certificate II and Group 3B units in the Certificate III and IV
  - CSG300 and NWP357 will be Group 2 units in the Certificate III and Group 3B units in the Certificate IV
  - CSG400 and CSG401 will be Group 2 units in the Certificate IV
- RIIENV201 will be packaged as a Group 3A unit for the Certificate II and a Group 3B unit for the Certificate III and IV.

All existing units are expected to remain available for selection as appropriate.

## Content of the new units

A quick, modified DACUM gave a good listing of components of the five required new units. This is listed in Appendix 3

# Feedback on the draft report

Feedback was mainly received from the industry with some from providers. Some feedback was collated by Manufacturing Skills Queensland and then forwarded as a combined response.

Most feedback supported the draft report and did not suggest any changes. Feedback on the Process Flow Map was positive.

Some feedback queried some aspects of the report and this led to the changes between the draft and the final report to clarify these aspects.

One comment suggested a robust review be included in the rollout of the new units to gauge issues that may arise from industry usage and RTO delivery. Such an implementation review is not normally part of the development process. However, MSA has a track record of responding to such feedback and dealing with it through the continuous improvement process.

# Conclusion and recommendations

This is a growing and significant sector, covering natural gas production and water treatment (and LNG). It will require a significant workforce in a very short time. Great effort and possibly some innovative solutions will be required to provide an adequate and competent workforce in the required time.

Five new units have been proposed and these should be developed.

Two additional units from other Training Packages have been identified. These should be imported into PMA08.

The differences between CSG and traditional gas are significant at the upstream end and this is where the new units are concentrated. Downstream has some differences but they are relatively insignificant.

This is a new sector (say up to ten years old) and so the technology and process has yet to stabilise and become consistent across the industry. A watching brief will need to be maintained to ensure PMA08 remains well aligned to the needs of the sector and that these changes do deliver the expected result.

This sector will create a significant hydrocarbons presence on the east coast, balancing the current west coast predominance.

# Appendix 1 Expert group members

The following participated in this activity.

The workshop was held at Origin Energy's head office in Brisbane. Their hosting of this workshop is gratefully appreciated.

Ben Hethorn – Origin Energy; Brisbane

Susan Rankine – Origin Energy; Brisbane

Brett Woods - Santos, Brisbane

John Chambers – Santos, Brisbane

Wolfie Baart - Santos, Adelaide (Apology for workshop)

Phil Wiley – QGC, Brisbane (Apology for workshop)

Julie Keddie – MSA, Brisbane (Apology for workshop)

Richard Lindner - MSQ, Brisbane

Kevin Hummel – TaPS, Sydney.

# Appendix 2 List of CSG units

## Existing units

### *PMA08*

- PMAOPS101C Read dials and indicators
- PMAOPS201B Operate fluid flow equipment
- PMAOPS204B Use utilities and services
- PMAOPS205B Operate heat exchangers
- PMAOPS206B Operate separation equipment
- PMAOPS216B Operate local control system
- PMAOPS221B Operate and monitor prime movers
- PMAOPS222B Operate and monitor pumping systems and equipment
- PMAOPS223B Operate and monitor valve systems
- PMAOPS230B Monitor, operate and maintain pipeline stations and equipment
- PMAOPS231B Control gas odourisation
- PMAOPS232B Produce product by filtration
- PMAOPS280A Interpret process plant schematics
- PMAOPS304B Operate and monitor compressor systems and equipment
- PMAOPS305B Operate process control systems
- PMAOPS320B Conduct artificial lift
- PMAOPS324A Operate a gas turbine
- PMAOPS326B Produce product using gas absorption
- PMAOPS330B Communicate pipeline control centre operations
- PMAOPS335A Conduct pipeline pigging
- PMAOPS410B Monitor remote production facilities
- PMAOPS411B Manage plant shutdown and restart
- MSAPMOPS212A Use enterprise computers or data systems
- MSAPMSUP240A Undertake minor maintenance
- MSAPMSUP292A Sample and test materials and product
- MSAPMSUP382A Provide coaching/mentoring in the workplace

### *To be imported*

- RIIENV201A Identify and assess environmental and heritage concerns

- NWP357B Monitor, operate and control reverse osmosis and nano filtration processes

## Proposed new units

- CSG200 Monitor wells and gathering systems
- CSG201 Monitor and operate compressors
- CSG300 Operate wells and gathering systems
- CSG400 Manage wells and gathering systems
- CSG401 Commission wells and gathering systems

# Appendix 3 New units – DACUM cards

The following is simply a record of the data contained on the cards from the modified DACUM. There has been no attempt to organise these or to eliminate duplication. This will be addressed in the draft units. Some proposed drafts were also obtained for some units. They are not listed here.

## CSG200 Monitor wells and gathering systems

This competency would be expected to be fully achieved within six months. It is proposed as a unit for inclusion at the Certificate II level

- Complete well reads (for each well's performance), compare to expected conditions and report as required
- Check water, gas and battery levels and RTU (remote terminal unit) information
- Check RTU calibration
- Check pumping well battery and lubricating oil levels and pump speed
- Do minor maintenance (eg lubrication)
- Drain gathering system low levels
- Check autodump on drains
- Check and drain low points
- Check high point vents (two way – pressure/vacuum)
- Check water lines for leaks
- Complete well lease maintenance – erosion control, kill weeds, check fences and gates
- Top up storage levels for chemical injections
- Read log sheet
- Enter log sheet data into computer system

Once competent, this person works alone driving one and off roads, identifying hazards and taking appropriate action.

(Jargon: trip (CSG jargon) = swing (off shore jargon))

## CSG201 Monitor and operate compressors

This unit is proposed as a unit for inclusion at the Certificate II level.

This unit does use utilities, may be used to provide suction and generates moderately low pressure. It is used in standalone operation and may have air cooling. It will have an ancillary lubricating system which operates with the compressor.

- Check and top up lubricating oil levels
- Take reads for air system, intake and discharge temperatures
- Adjust discharge pressure
- Isolate/deisolate
- Report as required
- Start up/shut down.

## CSG300 Operate wells and gathering systems

This unit is proposed as a unit for inclusion at the Certificate III level. This competency would be expected to be fully achieved within two to three years.

- Check valve operation
- Clean strainers and report findings (strainers may be on pumps or other lines)
- Check metering calibration
- Adjust drive head power units – check belt tension and/or top up hydraulic oil levels
- Monitor and operate fuel gas system – change/top up desiccant
- Monitor well fluid levels (eg with sonalog)
- Adjust pump speed to maintain correct well water level above pump suction
- Read downhole drawings (DHDs)
- Start up/shut down well
- Recognise and notify required maintenance tasks
- Isolate/deisolate for maintenance or workovers
- Operate flare
- Check corrosion control system eg cathodic protection

- Adjust control valves (eg float valves)

This person should also be competent in CSG200

## CSG400 Manage wells and gathering systems

This unit is proposed as a unit for inclusion at the Certificate IV level.

- Recommend well stimulation
- Interpret interwell communication (eg pressure, flow)
- Optimise flow – analyse network and recommend changes
- Manage individual wells – eg choke priority
- Liaise with maintenance and prioritise work
- Solve start up/shut down problems
- Control flows to meet plant requirements
- Liaise with plant eg for plant shut down
- Investigate well status determine action and report
- Liaise with/coordinate field operators re field work, shut ins, maintenance etc.

This person should also be competent in CSG300

## CSG401 Commission wells and gathering systems

This unit is proposed as a unit for inclusion at the Certificate IV level. This unit has a narrower focus than CSG400 and could be a career path step for someone wishing to achieve CSG400.

Once competent it may take a day to commission a new well. This competency is performed after precommissioning (eg by contractor or projects) is complete.

- Accept handover from projects or drilling/construction crew of new well system
- Ensure plant and equipment are operationally sound
- Ensure documents match the ‘as is’ plant and equipment
- Bring up (on) new well
- Introduce product to gathering system
- Test nearby wells for impact of new well

- Liaise with relevant operational personnel until operational issues are resolved
- Ensure support systems are working correctly (eg fuel gas, lubricating oil)
- Commission gathering system (eg check valves operate correctly, contaminants are within satisfactory levels)
- Match test pressure etc to documented levels
- Check well liquid level and adjust pump speed to maintain correct level
- Balance well and gathering system
- Ensure telemetry (communications to base) and control system operates and DCS screen updates are functional.

This person should also be competent in CSG300