Fitness for Purpose Report

Petroleum Wells.

For Compliance with the Petroleum Act 2000
South Australia.

January 2002.

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Explanation

This Fitness For Purpose Report covers petroleum wells constructed, operated, maintained and abandoned by Santos in the South Australian Cooper Basin.

This section was inadvertently omitted from the original Fitness For Purpose Report previously submitted. This report has therefore been prepared as an addendum to the earlier report.

In future, it is intended that petroleum wells be included within the body of the main report.

Fitness For Purpose Report (Addendum)

Petroleum Wells

1.0 INTRODUCTION

This section of the Fitness For Purpose Report (FFP) addresses petroleum wells drilled by Santos in the South Australian Cooper Basin (SACB). This report has been prepared as an addendum to the Santos Cooper Basin Fitness For Purpose Report.

At the time of preparing this report, a total of 1452 wells have been drilled by Santos and the Joint Venture parties in the SACB. These wells fall into the following categories, with the number of wells in each category shown,

Cased and Suspended	(C & S)	88
In Production		844
Abandoned		520

2.0 TYPES OF WELLS

Wells are generically split into two main types: monobore and conventional designs.

Conventional wells are lined with production casing which is cemented in place. Hydrocarbons from the producing zones are brought to the surface in a separate, smaller piping system (tubing) that is installed inside the production casing.

In monobore wells, the production casing is cemented in the ground in a similar fashion as in conventional wells, however, the one size (mono) casing, generally of a smaller diameter, is installed. This pipe system is also used as the producing conduit. No tubing is run in these wells.

Santos gas wells use both conventional completion and monobore completion designs, depending primarily on the expected production rates and the expected production life of the individual well. The flexibility to modify or change the construction of the completion is reduced with a monobore construction when compared to a conventional well.

Santos oil wells almost exclusively are of the conventional design. Oil wells generally require a form of artificial lift to increase or maintain the production rates at optimum levels. Conventional well designs provide a much better degree of flexibility in the choice of artificial lift that can be installed.

3.0 FACILITY DESCRIPTION

The key components of a typical well, as shown in the attached downhole diagrams, and consist of the following components,

- Casing, which includes the cement system.
- Wellbore tubing.
- Wellhead
- Perforations
- Packer

The diagrams include a typical downhole well completion for conventional and monobore wells. A copy of a typical gas wellhead is also attached.

3.1 Well Design

Well design is undertaken by professionally qualified, experienced engineers. Santos well design, including the casing and cementing systems, are based on internationally recognised Standards, and industry practice, including the American Petroleum Institute (API) Standards.

Modification to typical well design have been incorporated into Santos wells where experience and knowledge has identified improvements which are considered to be better, in terms of safety, operability and fitness for purpose, than the relevant Standard.

Strict change management practices have been adopted. These practices require detailed review and approval of any change to drilling or completion programs prior to the change being approved for implementation.

3.2 Drilling Program

A specific “Drilling Program” is developed for each well. This program identifies;

- the targeted horizons for the well,
- the mud program,
- casing depths and cementing programs, with due consideration of zonal isolation,
- coring and sampling programs
- Logging and testing programs.
- Time / Depth curves
- Abandonment procedures

3.3 Well Construction

3.3.1 Site Selection

Well construction commences with the identification of a site. The location of the site is determined from geological information and modelling to target potential hydrocarbon resources.

The sub-surface information is used to determine the position of the well on the surface and once identified, the surface location for the well is reviewed with due consideration to features such as drainage channels, vegetation, surface infrastructure and environmental and other considerations. The well surface location may be moved within defined parameters to allow the most appropriate location to be used.

3.3.2 Site Access

Following site selection, access is then developed. Access normally consists of the construction of a basic, narrow road to allow trucks to carry the drilling rig to the location. The access route is selected so as to provide appropriate access with consideration of distance, topographical features and terrain, minimisation of vegetation clearance and to prevent impact to apsects of Aboriginal and other heritage.

3.3.3 Site Preparation

A pad, of approximately 120 metres by 120 metres is constructed at the location on which the drilling rig is established. This pad also allows the storage of wellbore tubulars, water and fuel supplies and other equipment necessary for the drilling of the well.

A water supply is provided for the rig site. Water is used primarily for drilling "mud". Drilling mud consists of materials mixed in water which is circulated continuously through the drill string. The purpose of the mud includes,

- cooling and lubrication of the drill bit
- carrying drill cuttings to the surface.
- providing a hydraulic "head" for well control purposes.

3.3.4 Drilling

When the drilling rig is established on the chosen site, drilling operations commence in accordance with the predetermined program.

Santos utilises drilling rigs and equipment contracted from recognised and experienced well drilling contractors. Particular attention is paid to the rigs and equipment to ensure they,

- satisfy all relevant safety requirements.
- the rigs and equipment are fit for purpose.
- risks are reduced to as low as is reasonably practicable.

In the event the well encounters hydrocarbon reserves, a decision is made to either case and suspend or complete the well. In the event that non-commercial quantities or no hydrocarbons are encountered, the well is likely to be plugged and abandoned (P&A).

3.3.5 Cementing Programs

Cementing programs are specifically designed to secure the wellbore casing and provide isolation of aquifers and hydrocarbon reservoirs to prevent undesirable crossflow and contamination.

In P&A wells, 90m long cement plugs are strategically located to isolate hydrocarbon zones and hydraulically separate water producing intervals. The shoe of the last casing string in the well is also covered with a 100m long plug. This plug is “tagged” with a work string after the cement has set up to confirm the plug location and integrity.

Cements used in well cementing operations, including abandonment, meet internationally recognised standards, and are also laboratory tested to confirm suitability.

4.0 WELL OPERATIONS

Wells are operated by Santos personnel,

Gas wells may be remotely monitored from the main Control Room in the Moomba Plant. Information in relation to rate, pressure and temperature is provided to the Control Room operator

Information provided by a data collection system is reviewed by Petroleum Engineers to monitor well performance.

A recent change has been made to the specifications for the tubing string installed in some wells. This change was introduced due to the corrosion that occurred to the tubing in some high CO_2 content gas wells. The change has involved the introduction of tubing with a higher chromium content in the steel used to manufacture the tubing. This pipe is also installed in the monobore wells and has effectively resolved the corrosion problem.

5.0 RISK IDENTIFICATION

The significant risks associated with well construction are identified in Table 1.

These risks are managed to as low as is reasonably practicable by a variety of means as detailed in Table 1.

Where unacceptable risks (frequency or consequence) are identified, remedial operations are conducted to reduce the risk to acceptable levels. An example of such a risk reduction activity involved the conversion of wellbore tubing to a high chromium content tubing where elevated amounts of CO2 in the gas stream resulted in accelerated levels of tubing corrosion.

6.0 RISK ASSESSMENTS

Assessments as the Fitness For Purpose of well construction are reviewed at various times on an ongoing basis. These assessments include the following,

a) Corrosion logs of the well bore.
b) Pressure monitoring of wellobore annuli.
c) Detailed review of any equipment failure and corrective actions.
d) Application of corrosion inhibitors and testing of fluid streams to monitor corrosion.

An independent Risk Assessment was undertaken in June 2000 of the well abandonment practices and procedures for both conventional and monobore wells where the casing integrity is sound.
This risk assessment did not identify any significant issues that warranted the review or change of practices or procedures.
This risk assessment was undertaken by Advanced Well Technologies of Perth (WA).

For any problematic well, a specific well repair or abandonment program is developed for individual risk assessment. Approval of the final program is then sought from PIRSA, prior to the abandonment activity taking place.

During the latter part of 2001, a review was made of zonal isolation and well abandonment practices for inclusion in a Downhole Environment Impact Report for the review of a Statement of Environmental Objectives for well operations. The review consisted of a literature search and identification and comparison of practices and procedures from various internationally recognised standards and organisations. These organisations included,

- API
- The Alberta (Canada) Energy & Utilities Board.
- University of NSW.

This review identified that Santos cementing practices meet, and in many instances exceed the requirements of the Standards, practices and procedures reviewed.

7.0 FITNESS FOR PURPOSE.

Based on the ongoing review, monitoring and maintenance of wellbores, well operations and conduct of well workovers, Santos considers that the

- construction materials, methods and equipment, and
- practices and procedures, associated with well
  - design and construction,
  - operations,
  - monitoring,
  - well maintenance
  - modification, and
  - abandonment

result in oil, gas and water wells which are fit for purpose.

Because of both the existing and ongoing review and monitoring of wells, it is considered that this status will remain unchanged, for at least the next 5 years.

7.1 SECURITY OF SUPPLY

The risks to "security of supply" posed by any individual gas well or group of wells is assessed as being low. This assessment results from two main aspects,

- the number of gas wells from which gas is produced and the widespread nature of the geographic location of these wells, which results in a very low risk of any "knock on effect".
- the methods, materials, practices and procedures associated with well design and construction, operation and monitoring, as detailed in 7.1 above.

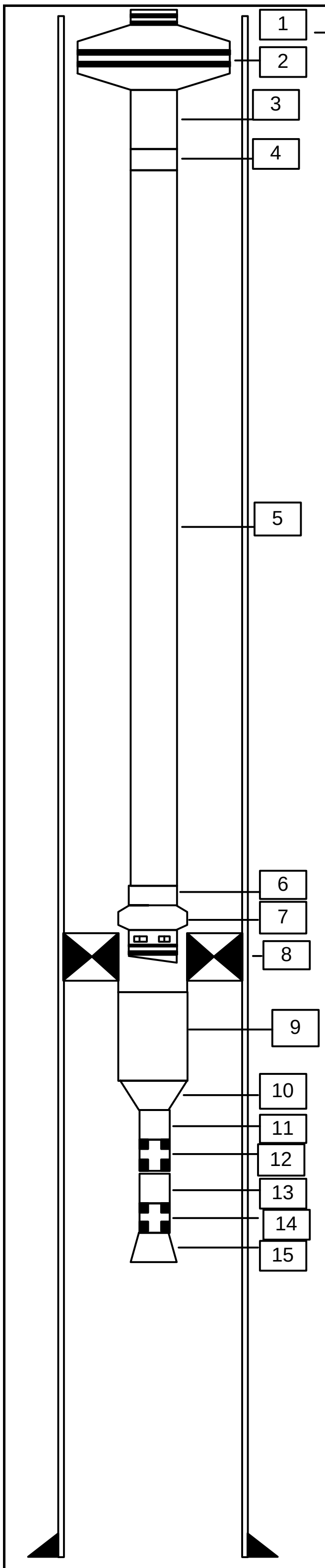
While the risk to "security of supply" are assessed as low, procedures are maintained, including direct access to international experts in well control, to enable any well problem to be quickly controlled.

8.0 Glossary of Terms

Completion	This term describes the methods and procedures by which a flow path is established in a well that allows the production of fluids from or into a discrete formation or formation in a well.
Conventional Well	The construction of a well in which wellbore casing is cemented into a well after drilling and a separate wellbore piping system (tubing) is installed for the production of wellbore fluids.
C&S	Cased and Suspended Well. This is a well, where after drilling, the wellbore is cased and cemented, but the well is not completed for perforated. The various formations remain isolated from each other and from the wellbore.
Monobore	A well in which only one string of pipe is run into the well and cemented. This pipe and the associated cement system serves to isolate the various productive zones and aquifers and also to allow the production of fluids to the surface.
Perforate	Perforating is the activity undertaken to provide access to the wellbore of reservoir fluids. This activity is generally undertaken with the use of explosives in the wellbore which puncture the tubing and casing.
P & A	To Plug and Abandon a well involves a series of actions to isolate the well bore from the productive zones. Abandonment is generally achieved by setting cement plugs at strategic locations across the perforations and in the wellbore.
SACB	South Australian Cooper Basin

PETROLEUM ENGINEERING DEPARTMENT
CONVENTIONAL DOWNHOLE COMPLETION
WELL: TYPICAL WELL #1

DATE: 17/01/99



ITEM No.	DESCRIPTION	LENGTH (ft)	DEPTH KB (ft)	MIN. ID (in)
	TUBING STRING			
1	K.B. to top of tubinghead spool	16.10	0.00	
2	Tubing hanger COT FBB-EN 2-7/8" NK3SB b x CS-Hydril b	0.83		
3	1 x 2-7/8" 6.5# 13Cr80 NK3SB-SC tubing HT00452	31.47		
4	5 x 2-7/8" 6.5# 13Cr80 NK3SB-SC pup jts 10'- HT06676,	29.50		
	8', 6' - HT15244 & 2' (no HT#)			
5	245 joints 2-7/8" 6.5# 13Cr80 NK3SB-SC tubing HT39595	7704.02		
6	X-over 2-7/8" NK3SB p c/w collar (3.5"OD) x BH3 p 13Cr80	1.33		
7	Baker G22 Seal Assembly Size 80-32, 2-7/8" BH3 b	0.50	7783.25	
	c/w extra 80-32 seal unit(Length =4.83')			
	PERMANENT DOWNHOLE EQUIPMENT			
8	Baker 7" DB packer, 4-1/2" BH3 Size 84-32 (7786' MPOR)	3.92	7783.75	
9	Millout Extension 4-1/2" BH3 p x p	5.43		
10	Swage 4-1/2" BH3 x 2-3/8" BH3 b x p J55	1.78		
11	1 x 12' x 2-3/8" 4.7# J55 BH3 pup joint	11.94		
12	OTIS Landing Nipple 711X18701 2-3/8" BH3 b x p	0.97	7806.82	**1.875**
13	1 x 12' &1 x 10' x 2-3/8" 4.7# J55 BH3 pup joints	21.88		
14	OTIS Landing Nipple 711XN18715 2-3/8" BH3 b x p	1.07	7829.67	**1.791**
15	Re-entry guide 2-3/8" BH3 x 2-7/8" Blank J55	1.00		
	Bottom of tailpipe		7831.74	

PERFORATION INTERVALS: GUN: CHARGES:

FORMATION	INTERVAL (FT / KB)	SIZE	TYPE	PHASE	SPF	TYPE	WT(g)
Reperf 11-12/99							
79-6	7970 -8011	1 11/16	Pivot	180	4	RDX	22
80-1	8018 -8045	1 11/16	Pivot	180	4	RDX	22
Patchawarra							
78-8	7894 - 7905	4.5"	Csg	135°/45°	12	RDX	20.5
79-4	7941 - 7951	4.5"	Csg	135°/45°	12	RDX	20.5
79-6	7970 -8011	4.5"	Csg	135°/45°	12	RDX	20.5
80-1	8018 -8045	4.5"	Csg	135°/45°	12	RDX	20.5
80-5	8069 -8085	4.5"	Csg	135°/45°	12	RDX	20.5
81-4	8157 - 8162	4.5"	Csg	135°/45°	12	RDX	20.5
	8174 - 8201	4.5"	Csg	135°/45°	12	RDX	20.5
82-2	8229 - 8231	4.5"	Csg	135°/45°	12	RDX	20.5
	8238 - 8254	4.5"	Csg	135°/45°	12	RDX	20.5
82-8	8288 - 8301	4.5"	Csg	135°/45°	12	RDX	20.5
83-1	8324 - 8327	4.5"	Csg	135°/45°	12	RDX	20.5
84-7	8471 -8479	4.5"	Csg	135°/45°	12	RDX	20.5
85-0	8501 - 8505	4.5"	Csg	135°/45°	12	RDX	20.5
85-3	8546 - 8564	4.5"	Csg	135°/45°	12	RDX	20.5

ANNULUS FLUID:	9.1+ ppg 2% KCL Brine plus 1 drum Applied 2100 Inhibitor.
INDICATED STRING WEIGHT:	48,000 lbs (string weights include 4000# for blocks)
CALCULATED STRING WEIGHT:	47,500 lbs
SLACK-OFF WEIGHT:	4,000 lbs

NOT TO SCALE	Wellsite Representative	John Smith	
COMPLETION: Rig 1	DATE OF INSTALLATION	15/05/1995	
	Modified: Jane Smith	DATE:	17/01/1999
	CHECKED: Jane Smith	DATE:	17/01/1999

BTD - 8660' KB (Logger, 13/5/95)

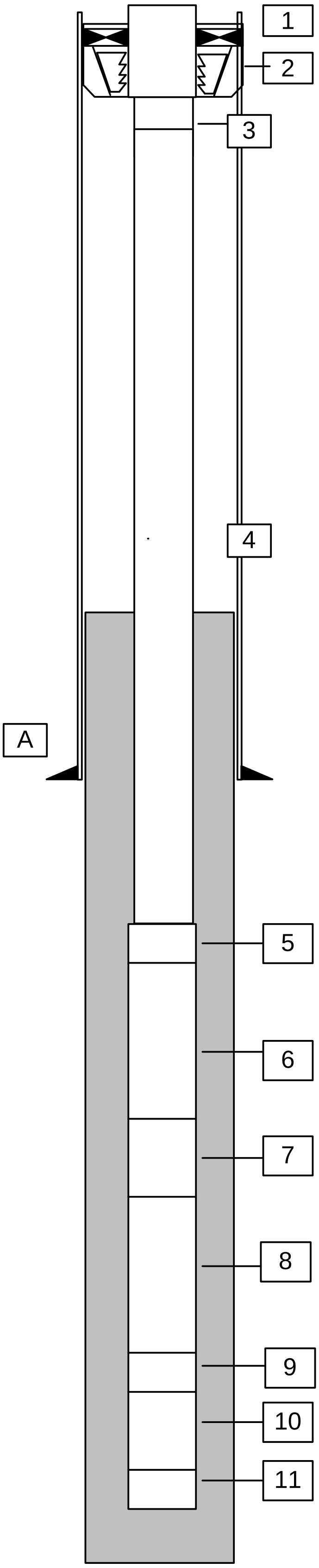
PETROLEUM ENGINEERING DEPARTMENT

DOWNHOLE COMPLETION

WELL: Typical #2

COMPLETION DATE: 20/07/01

DRAWING DATE: 03/12/01



PBTD - 9041 RT ' KB

ITEM	DESCRIPTION	LENGTH	DEPTH KB	MIN. ID
No.		(ft)	(ft)	(in)
1	K.B. to top of tubinghead spool	18.80	0.00	
2	3-1/2" Slip and seal assembly (Type SB-3)	0.00	18.80	
3	191 joints 3-1/2" 13Cr95 9.2# FOX tubing	7724.79	-4.00	2.992
4	11 joints 3-1/2" J-55 FOX 9.2# tubing	446.38	7720.79	
5	1 Marker joint 13Cr95 9.2# FOX tubing	10.28	8167.17	
6	14 joints 3-1/2" J-55 FOX 9.2# tubing	568.46	8177.45	
7	1 Marker joint 13Cr95 9.2# FOX tubing	10.30	8745.91	
8	7 joints 3-1/2" J-55 FOX 9.2# tubing	284.20	8756.21	
9	Float collar (Davis Lynch)	1.19	9040.41	
10	1 joint 3-1/2" 13Cr95 9.2# FOX tubing	40.60	9041.60	
11	Float shoe (Davis Lynch)	1.36	9082.20	
	Bottom of tubing		9083.56	
A	Surface casing 7-5/8" L-80 26.4lb/ft BTC	2905.44	2925.14	
	Frac conducted on Epsilon on 12/08/01			
	Frac conducted on Toolachee on 22/08/01			

PERFORATION INTERVALS:

FORMATION	INTERVAL (' KB)	GUN: SIZE	TYPE	PHASE	SPF	CHARGES: TYPE	WT(g)
Epsilon 06/08/01							
79-4	8794 - 8808	2"	BH	60°	6	HMX	6.5
Toolachee (16/08/01)							
76-3	8186 - 8190	2"	BH	60°	6	Pred	6.5
76-4	8202 - 8206	2"	BH	61°	6	Pred	6.5
76-5	8238 - 8249	2"	BH	62°	6	Pred	6.5
76-6	8256 - 8270	2"	BH	63°	6	Pred	6.5
76-7	8286 - 8296	2"	BH	64°	6	Pred	6.5
76-8	8301 - 8320	2"	BH	65°	6	Pred	6.5
Toolachee (27/11/01)							
74-3	7998 - 8004	2"	BH	65°	6	Pred	6.5
74-5	8034 - 8046	2"	BH	65°	6	Pred	6.5
Epsilon 27/11/01							
79-4 (Re-Perf)	**8794 - 8808**	2"	BH	65°	6	Pred	6.5

REMARKS:

ANNULUS FLUID:

INDICATED STRING WEIGHT:

CALCULATED STRING WEIGHT:

SLACK-OFF WEIGHT:

TENSION:

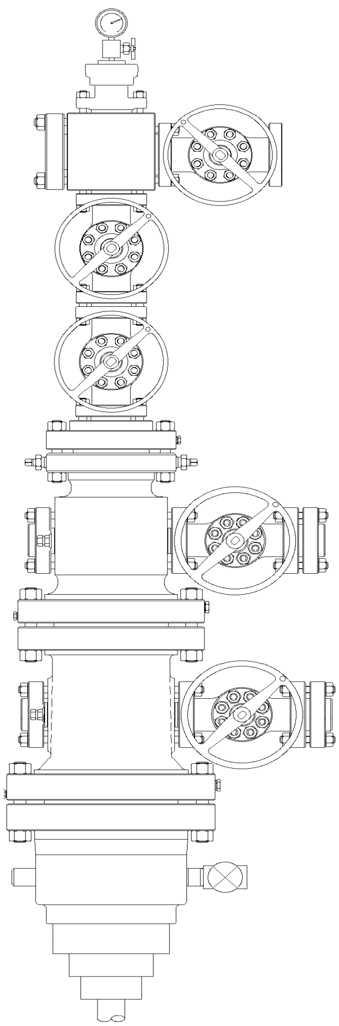
NOT TO SCALE		WELLSITE SUPERVISOR	
PROPOSED:		DATE OF INSTALLATION	
RE-COMPLETION:		DRAFTED BY: John Smith	DATE:03/12/01
COMPLETION:		REVISED BY:	DATE:
OTHER:		CHECKED BY: Jane Smith	DATE: 23/12/01

PETROLEUM ENGINEERING DEPARTMENT

SINGLE 2-9/16" WELLHEAD AS INSTALLED

WELL: Typical #1

DATE: 16/05/95



DESCRIPTION				
TREE CAP		MAKE/TYPE	COT	
		SIZE/RATING	2-9/16 / 3000	
		LIFT THREAD	2-7/8" EUE	
		FITTINGS	1/2" Needle Valve	
FLOW CROSS		MAKE	COT	
		SIZE	2-9/16" x 2-9/16" x 2-9/16" 2-1/16"	
		RATING	3000	
	OUTLET	FITTINGS	2-9/16" flange tapped 1/2" NPT c/w Bull plug	
	WING VALVE	MAKE/TYPE	COT / FL	
		SIZE/RATING	2-1/16" / 3000	
		TRIM	CR13/HF/CO	
		BODY	ALY	MTLS: BB
		ASSY NO.	141501-21-52-02	S/N: FB 249 000
UPPER MASTER VALVE		MAKE / TYPE	COT / FC	Gate: CR13CR
		SIZE	2-9/16"	Stem: S/S
		RATING	3000	Seat: No Entry
		TRIM		Body: S/S-2
		P/N	32902-7-3	S/N: D-6201
LOWER MASTER VALVE		MAKE / TYPE	COT / FC	Gate: CR
		SIZE	2-9/16"	Stem: SS
		RATING	3000	Seat: CR13 PL Stellite
		TRIM		Body: SS-2
		P/N	32902-7-3	S/N: D-62022
ADAPTOR FLANGE		MAKE/TYPE	COT / Seal Pocket	
		SIZE/RATING	7-1/16" x 2-9/16" / 3000	
TUBING SPOOL		MAKE/TYPE	CIW / F	
		SIZE/RATING	7-1/16" x 11" / 3000#	
	OUTLET 1	VALVE	CIW 2-1/16"x 3000 Gate Valve CIW 2-1/16" Comp Flng	
	OUTLET 2	FITTINGS	CIW 2-1/16" Comp Flng / 1-1/2"VR plug	
*CASING SPOOL		MAKE/TYPE		
		SIZE/RATING		
	OUTLET 1	VALVE	Not Applicable	
	OUTLET 2	FITTINGS		
CASING BOWL		MAKE/TYPE	COT / F	
		SIZE/RATING	9-5/8" x 11" / 3000	
	OUTLET 1	VALVE	2" NPT Ball Valve (Open) to surface casing riser vent	
	OUTLET 2	FITTINGS	2" NPT Bullplug (Solid)	
SURF. CSG.	SIZE,WT./GR./THD./DEPTH		9-5/8" 36# K55 LTC / 1815' KB	
*INT. CSG.	SIZE,WT./GR./THD./DEPTH		Not Applicable	
PROD. CSG.	SIZE,WT./GR./THD./DEPTH		7" 23# & 26# K55 L80 LTC / 8692' KB	
TUBING	SIZE,WT./GR./THD./# JTS.		2-7/8" 6.5#13CR80 NK3SB / 246 joints	
TUBING HANGER		MAKE/TYPE	COT / FBB-EN	
		LIFT THD./BPV PREP.	2-7/8" CS-Hydril / 2-1/2" H-1, H-2	
REMARKS	STRING WT.	INDICATED	48,000 Lbs	
		CALCULATED	47,500 Lbs	
		SLACKOFF WT.	4,000 Lbs	
		OTHER		

* INTERMEDIATE CASING INSTALLED?
NO

AUTHOR: John Smith, 15/05/95

CHECKED: Jane Smith, 16/05/95