D. G. H.
DFG.INFA 7/594
MLo/dc

FRIGG FIELD

TREATMENT COMPRESSION PLATFORM N° 2
. TCP2 .

DECK MATING,LOADING AND HOOK-UP IN FJORD
. ANDALSNES NORWAY .

1977 ELF Michel LOUW

- S U M M A R Y -

I LOCATION AND CHARACTERISTICS OF FRIGG FIELD

I - LOCATION AND CHARACTERISTICS OF FRIGG FIELD.

Located in the northern area of the North Sea, at the 60th parallel, and midway between the South Shetlands and BERGEN, the FRIGG gas deposit straddles the boundary-line between the British and Norwegian continental shelf areas. Depth of water at this point is approximately 100 meters.

The field was discovered in July, 1971, by ELF-NORGE, operating the Franco-Norwegian partnership known as PETRONORD, owner of the rights on the Norwegian side (bloc 25-1). This discovery was confirmed in May, 1972 by TOTAL OIL MARINE, operator of the French group, which holds the rights on the British side (bloc 10-1).

Following the large outputs (700.000 m3/day) of dry, sulphur-free gas (in the region of 95 % methane and 4 % ethane), which were obtained during preliminary tests, new drillings were carried out and these confirmed the extent of the deposit. This was declared "commercial" in April, 1972.

Workable reserves, estimated at about 200 million cubic meters, approximate those of LACQ ; however, the planned production rate for normal operation (15 billion cubic meters annually) will be twice that of the AQUITAINE-located deposit.


ANDALSNES
MAGNUS
THISTLE
DUNLIN
STATFJORD
CORMORANT
BRENT
HUTTON
SHETLAND
HEATHER
NINIAN
ALWYN
SULLOMVOE
FRIGG
HEIMDALL
BERYL
ORCADES
NORVEGE
ZONE NORVEGIENNE
FLOTTA
STAVANGER
SLEIPNER
PIPER
CLAYMORE
BREAM
MAUREEN
ANDREW
BRISLING
FORTIES
ST-FERGUS
PETERHEAD
MONTROSE
COD
HAMILTON BROS
ALBUSKJELL
TORFELT
JOSEPHINE
EKOFISK
AUK
ELDFISK
ZONE DANOISE
DANEMAR
ARGYLL
I
H
E
A6
F
M
N
DAN
A
ZONE BRITANNIQUE
TEESSIDE
ZONE NEERLANDAISE
ZONE ALLEMANDE
ROUGH
WEST SOLE
ANN
K6
L7
EASINGTON
PLACID
AMETHYST
VIKING
INDEFATIGABLE
EMDEN
HARLINGEN
THEDDLETHORPE
BROKEN BANK
SEAN
GRONINGUE
ZUIDWAL
LEEUWARDEN
DOTTIE
LEMAN BANK
BACTON
HEWETT
ALLEMAGNE FEDERALE
PAYS-BAS
GRANDE BRETAGNE
BELGIQUE
Gisement d'huile
Gisement de gaz naturel
Pipe-line de pétrole brut
Pipe-line de gaz naturel

DEPOSIT CHARACTERISTICS

Location	between 59°48' and 59°60' latitude North
	between 1°97' and 2°15' longitude East
Distance from Norwegian coast	190 km
Distance from Shetland Islands	180 km
Distance from Scottish Coast	360 km
Water depth at deposit	100 m
Depth of oil rig below sea level	1900 m
Maximum height of impregnation	140 m
Gas pressure	approximately 200 bars
Gas temperature	approx. 60 °C
Recoverable reserves	over 200 billion m^3

SHARE OF INTERESTS

1. British zone

FRENCH GROUP (100 %)

a) ELF AQUITAINE Group, represented by:
ELF OIL EXPLORATION AND PRODUCTION (U.K.) LTD 4/9
AQUITAINE OIL (U.K.) LTD 2/9

b) TOTAL Group, represented by:
TOTAL OIL MARINE LTD (operator) ..... 3 / 9

} FRENCH INTERESTS: 100 %

2. Norwegian zone

FRANCO-NORWEGIAN GROUPE PETRONORD (95 %)

a) ELF AQUITAINE Group, represented by:
ELF NORGE A/S (operator) ..... 27.613 %
AQUITAINE NORGE A/S ..... 13.807 %

b) TOTAL Group, represented by:
TOTAL MARINE NORSK A/S ..... 20.710 %

} FRENCH INTERESTS: 62.13 %

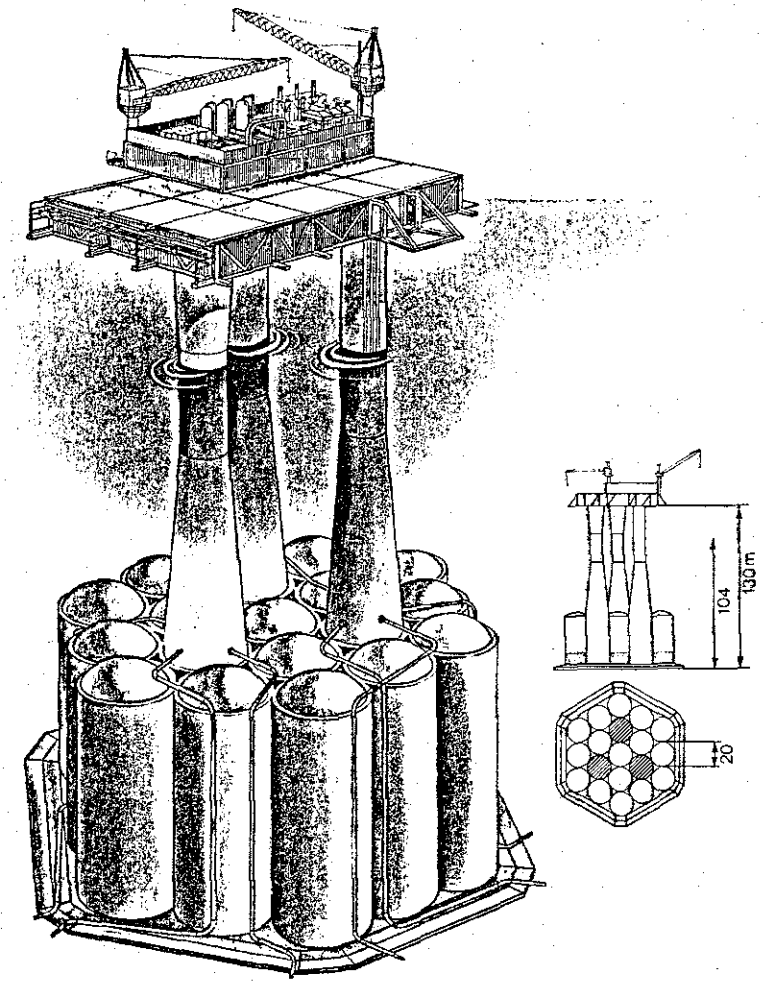
c) NORSK HYDRO ..... 32.870 %

OTHER INTERESTS (5 %)
– DEN NORSK STATS OL JESELSKAP (STATOIL) ..... 5.000 %

} NORWEGIAN INTERESTS: 37.08 %

II DESCRIPTION OF TCP.2

TREATMENT COMPRESSION PLATFORM 2



The concrete structure (1) of the TCP 2 platform consists of a caisson, formed by 19 cylindrical cells constructed on a hexagonal raft, and supporting three columns. 53 000 cubic meters of reinforced and prestressed concrete were required for its construction. The deck ("support-frame") which is of steel (2) and weighs 3 500 tons, will support the 8 000 tons of processing equipment distributed over some 4 500 square meters of area. The platform thus equipped and ballasted will weigh 306 000 tons.

With the exception of the mud center, which is installed only on the TP 1, equipment provided for the treatment of gas and condensates and for the service facilities (3) are similar to those of the TP 1: 3 drying lines for the gas; a 32' pipe for conveyance of the gas and condensates; production of electricity for the TCP 2, DP 2 and if necessary for the TP 1 and QP.

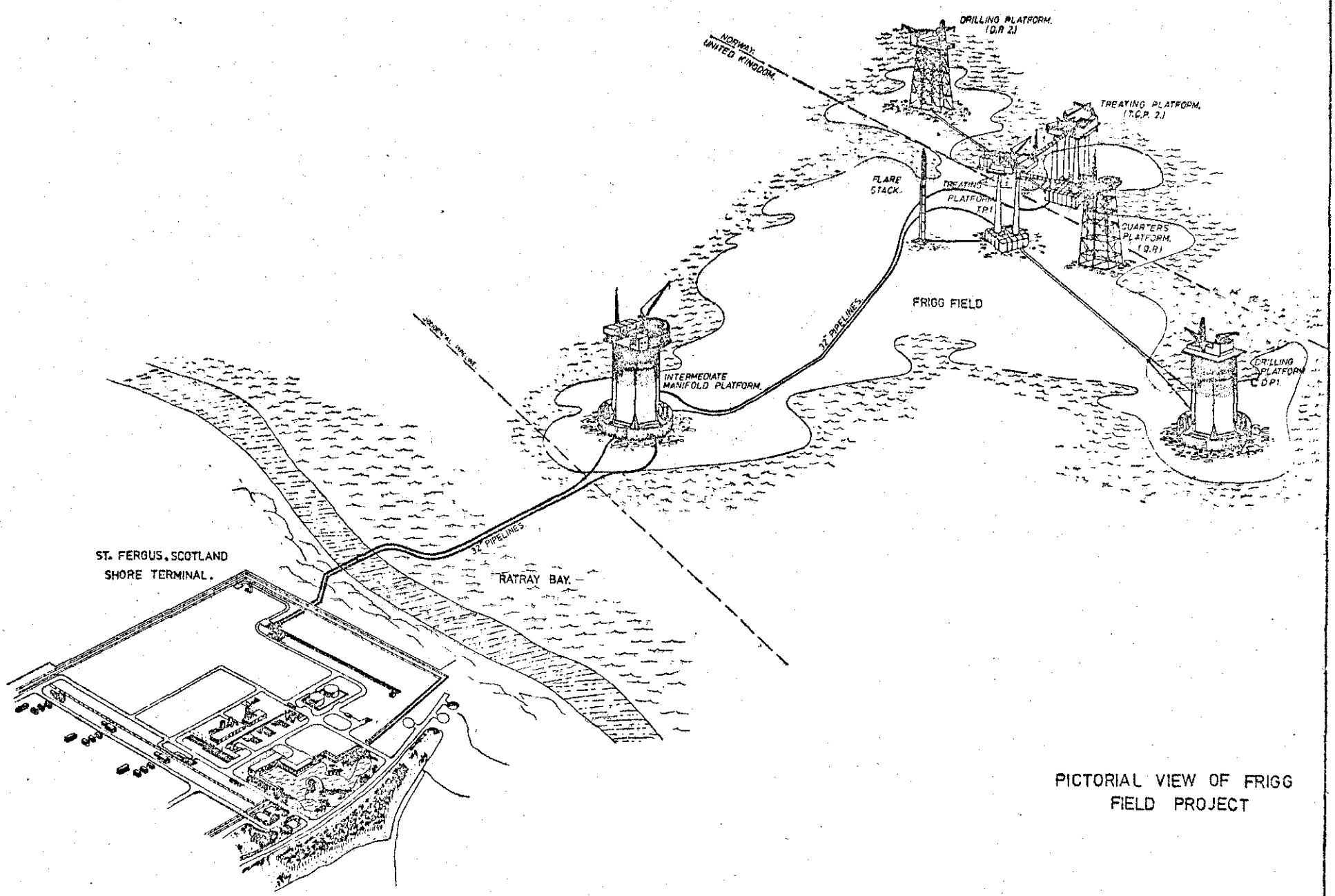
Recompression of the gas will be necessary when pressure at the well head becomes inadequate after a certain period of production. Provided for recompression of the total gas production of the field, the installations may reach a total power output of 200,000 hp; they will be installed progressively.

A gangway will link TCP 2 to the TP 1 platform, which is itself connected by gangway to QP.

(1) Designed according to the Norwegian CONDEEP (Concrete Deepwater Structure) process and constructed in Andalsnes, Norway, by the NORWEGIAN CONTRACTORS consortium.

(2) Constructed in Storó, Norway, By the AKER SHIPYARDS, In Dunkerque, France by CMP and assembled in Cherbourg, France by U.I.E./C.N.P.

(3) Constructed in Orkanger, Norway, by the Franco-Norwegian SPIE-VIGOR partnership.



PICTORIAL VIEW OF FRIGG FIELD PROJECT

REFERENCE DRAWINGS NUMBER	TITLE	REV NO.	REVISION	BY	DATE	CHD
		1	ROUTING PHASE II PIPELINE CORRECTED	JER	8/7/74	

Brown & Root, (U.K.) Ltd.
Engineering Contractors
LONDON, ENGLAND.

DRAWN	TRACED	CHECKED	APPROVED
BY JWL	JER		
DATE	2-8-74		

TOTAL OIL MARINE LIMITED
LONDON
FRIGG FIELD DEVELOPMENT
PHASES I & II.

SCALE	PROJECT No.	DRAWING NUMBER	REV.
N.T.S.		A1-MP-Y-125	1

III WORKS IN FJORD

III - WORKS IN FJORD.

At the beginning of the project, ANDALSNES fjord was selected for the construction of the concrete structure on the following grounds :

- site well sheltered against wind,
- town served by railway,
- easy access by sea,
- very deep fjord (about 250 m below) although far from the coast (about 60 km),
- several Condeep type platforms have been built in this place.

The concrete structure was built under favourable conditions and within the required time.

TCP.2 platform was assembled in this place :

- positioning of steel deck on columns,
- lifting and positioning of temporary and permanent equipment on deck,
- carrying out of hook up works and preparation of the transfer of the platform towards FRIGG Field.

SEAPONTOON 4 barge, measuring 100 x 30 m, towed by 2 tugs, total power of which is 17.000 horses, transported the support frame weighing 5.600 tons, equipment included, from CHERBOURG to ANDALSNES.

After 5 days at sea, the string came to the end of the voyage by reaching ANDALSNES fjord on March 25th, 1977.

In order to allow the positioning of the deck on the columns, the whole deck had to be transferred from one barge onto 2 barges (see explanatory diagram concerning the positioning of the deck on the structure).

This operation was realized as soon as the deck reached ANDALSNES and was achieved on March 28th, 1977.

The support frame on NORBARGES barges was trimmed along the quay of ANDALSNES harbour, with a view to load the first parcels.

The permanent equipment for gas treatment (M.D.H.) to be installed on the support frame before deck mating operation reached ANDALSNES on March 18th.

They were loaded on DINO I barge, coming from ORKANGER (Norway) where they had been fabricated by SPIE BATIGNOLLES VIGOR(S.B.V.).

On March 24th, BROWN & ROOT temporary equipment, accommodation units, helideck, generators set, etc... arrived as well. These equipment were fabricated in HAMBURG, Germany, and towed to ANDALSNES on MORLAND 5 barge.

- From March 28th to April 6th, 4.000 tons equipment were installed onto the support frame by means of E.T.P.M. 701 derrick barge, capacity of which is 700 t.

- The operation consisting in positioning the support frame on the concrete structure started on April 12th with the immersion of the 3 columns by ballasting, down to 121,2 m below level.

After the positioning of the support frame on the 3 columns, the platform was deballasted, in order to be brought, on April 18th, up to 100 m below level, which level will be kept until the end of the works in the fjord (level below the support frame : about + 25 m).

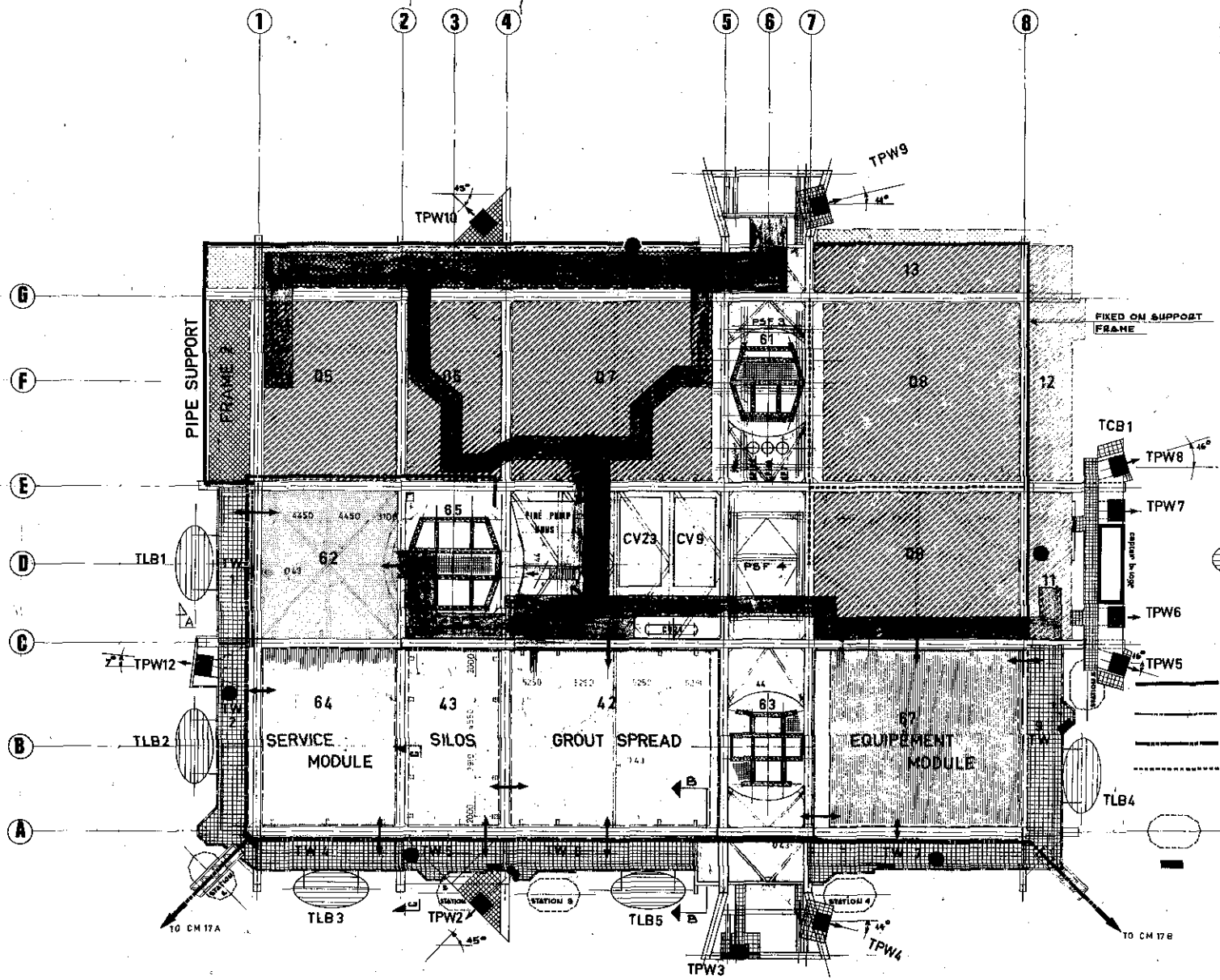
- The hook up of temporary and permanent equipment started on April 20th. Over 25 % of the hook up of the treatment modules was achieved within the period from April 20th to May 31st, and the temporary equipment (accommodation, equipment generators, etc...) were operational for June 8th, date of the departure of the platform to FRIGG.

- During this second phase, treatment modules n° 1, 2, 3 gas metering units 02 and 03, as well as accommodation module 74, helideck, captain bridge, were positioned by means of E.T.P.M. 1601 derrick barge.

- During the period the works were carried out in ANDALSNES, 2 stability tests were performed. The first one was performed on May 15th, after the deck mating operation and after positioning of the second set of equipment on the deck. The second one was performed on June 4th, before loading the last parcels. These tests determined a 1 m GM approximately, corresponding to a weight close to 12.600 t at the head of the platform.

- The platform left ANDALSNES site on Wednesday June 8th, that is one week before the date foreseen in the planning defined in August, 1976.

The five tugs, total power of which is 62.000 horses, towed the platform to FRIGG Field, at a 2 knots/hour average speed, it reached its final position on Wednesday June 22nd , 1977, at 2 A.M. after 8 days in stand by on FRIGG Field because of bad weather.



PLAN CELLAR DECK

Note: For the sections A-A, B-B and C-C see drawing 1.40.E2.0024

INDEX	DATE	REVISIONS	BY
8	28.2.77	Revised	MP
7	31.1.77	Add PSF 3 & 4	MP
6	30.12.76	Add CP16B, CP16A, CP7	Dendouve
5	26.11.76	Modification lifeboat Temp Sheeting Walkway	Dendouve
4	25.10.76	Modification of the Life boat	Dendouve
3	8.10.76	Modification access way	MP
2	30.9.76	REVISED	Dendouve
1	7.7.76	Add Module 67 Mod. Temporary walkway between E and C row 4	Dendouve
0	[illegible]	PRELIMINARY	[illegible]

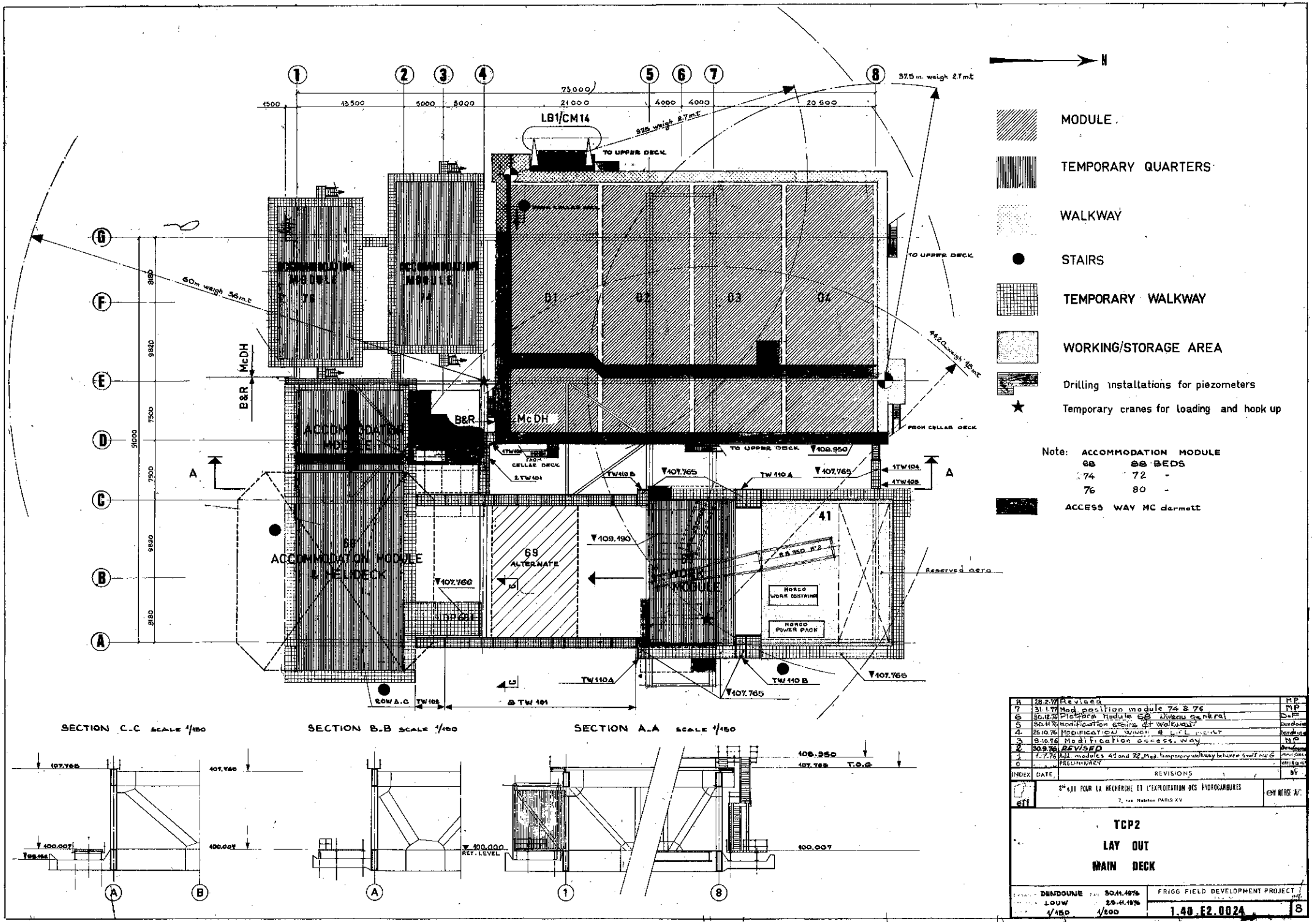
elf — Sté ELF POUR LA RECHERCHE ET L'EXPLOITATION DES HYDROCARBURES, 7, rue Nélaton PARIS XV — ELF NORGE A/S

TCP 2
LAY OUT
CELLAR DECK

DRAWN BY: DENDOUVE 30.11.1976
CHECKED BY: LOUW 30.11.1976
SCALE: 1/200

FRIGG FIELD DEVELOPMENT PROJECT

1.40.E2.0023 — 8



INDEX	DATE	REVISIONS	BY
R	28.2.77	Revised	MP
7	31.1.77	Mod position module 74 & 76	MP
6	30.12.76	Platform Module 68 Niveau général	DeE
5	30.11.76	Modification stairs et walkway	Dendoune
4	25.10.76	MODIFICATION WINCH & LIFT HEIGHT	Dendoune
3	8.10.76	Modification access way	MP
2	30.9.76	REVISED	Dendoune
1	1.7.76	Add. modules 41 and 72 Mod. temporary walkway between quelf rig G	[illegible]
0		PRELIMINARY	[illegible]

elf — Sté ELF POUR LA RECHERCHE ET L'EXPLOITATION DES HYDROCARBURES, 7, rue Nélaton PARIS XV — elf NORGE A/S

TCP2
LAY OUT
MAIN DECK

DENDOUNE 30.11.1976
LOUW 25.11.1976
1/150 1/200

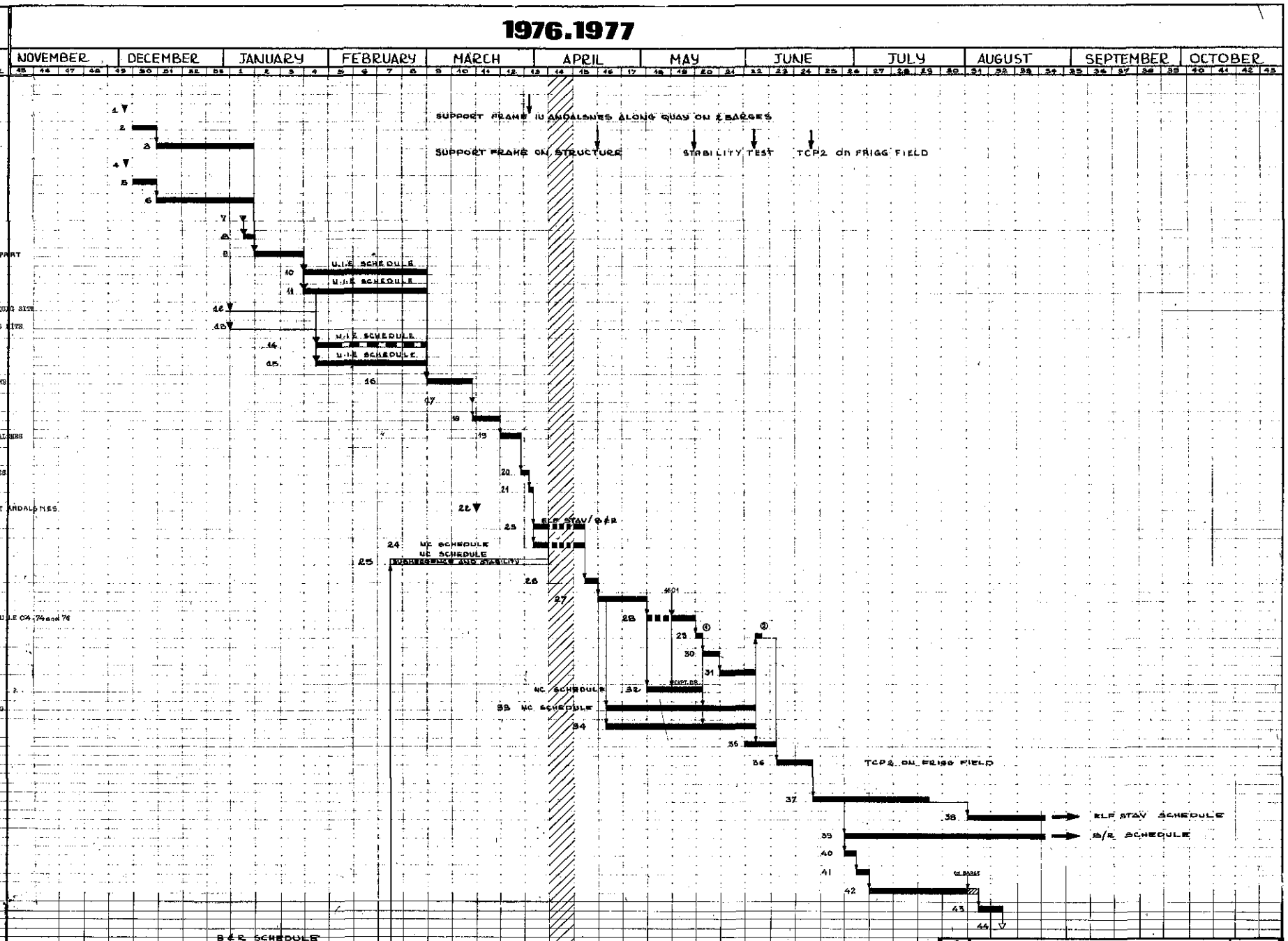
FRIGG FIELD DEVELOPMENT PROJECT

1.40.E2.0024 — 8

IV PLANNING

1976.1977

N°	ACTIVITY
	FINAL ASSEMBLY SITE CHERBOURG
1	SOUTH PART AVAILABLE STORE
2	SOUTH PART TRANSPORT TO CHERBOURG
3	SOUTH PART FINAL ASSEMBLY
4	NORTH PART AVAILABLE RANVILLE
5	NORTH PART TRANSPORT TO CHERBOURG
6	NORTH PART FINAL ASSEMBLY
7	CENTRAL PART AVAILABLE DUNKERQUE ON BARGE
8	CENTRAL PART TRANSPORT TO CHERBOURG
9	PREPARATION AND SKIDDING CENTRAL PART
10	FINAL ASSEMBLY OF THE SUPPORT FRAME
11	INSTALLATION SURPLUS EQUIPMENT LIST 1
12	PANCAKES 06 AND 07 LIST 2. AVAILABLE ON CHERBOURG SITE
13	OTHER EQUIPMENT LIST 2. AVAILABLE ON CHERBOURG SITE
14	LIFTING EQUIPMENT LIST 2
15	WORK ON EQUIPMENT LIST 2
16	LOAD OUT AND SEA FASTENING OF THE SUPPORT FRAME
17	SUPPORT FRAME READY FOR TOW TO ANDALSNES
18	STAND BY
19	TRANSPORT SUPPORT FRAME FROM CHERBOURG TO ANDALSNES
	IN MOOR ANDALSNES
20	TRANSFER SUPPORT FRAME FROM 1 BARGE TO 2 BARGES
21	MOORING OF SUPPORT FRAME ALONG QUAY
22	EQUIPMENT CELLAR DECK LEVEL AVAILABLE AT ANDALSNES
23	LOADING EQUIPMENT CELLAR DECK LEVEL
24	LOADING NORCO EQUIPMENT GROUNING ON SUPPORT FRAME AND STARTING HOOK-UP
25	PREPARE STRUCTURE FOR DECK MATING
26	DECK MATING
27	TENSIONING OF DECK TO STRUCTURE
28	LOADING EQUIPMENT MAIN DECK LEVEL EXCEPT MODULE 04, 74 and 76
29	STABILITY TEST
30	LIFTING MODULE 74
31	SECURE MODULE 74 AND HOOK UP
32	LOADING NORCO TOWING EQUIPMENT AND HOOK-UP
33	HOOK-UP NORCO OF EQUIPMENT NECESSARY FOR TOWING
34	HOOK-UP OF UTILITY AND ACCOMMODATION
35	FINAL REQUIREMENT BEFORE TOW OUT
36	TOW OUT AND GETTING DOWN OF TCP2
	OTHERS
37	GROUTING OPERATIONS
38	HOOK-UP
39	PULLING OF LINES
40	SURVEY DEFINITION OF BRIDGE LENGTH
41	ENGINEERING STUDY FOR ADJUST OF LENGTH
42	ADJUST LENGTH OF BRIDGE BY CONTRACTOR INCLUDING LOAD OUT AND SEA FASTENING
43	TRANSPORT TO FRIGG FIELD
44	BRIDGE ON THE FRIGG FIELD READY FOR LIFTING
45	B & R WORK ON STRUCTURE, RISERS AND J. TUBES



IND	DATE	REVISION
6	15.5.77	Activity 16 to 44
5	8.5.77	Activity 16.18.23.24.26.27.28.29.30.31.32.33.34
4	31.4.77	Activity 7.8.9.10.11.14.15.16.17.18.

Cie FRANÇAISE POUR LA RECHERCHE ET L'EXPLOITATION DES HYDROCARBURES
7, rue Nelaton PARIS XV

ELF NORGE A/S

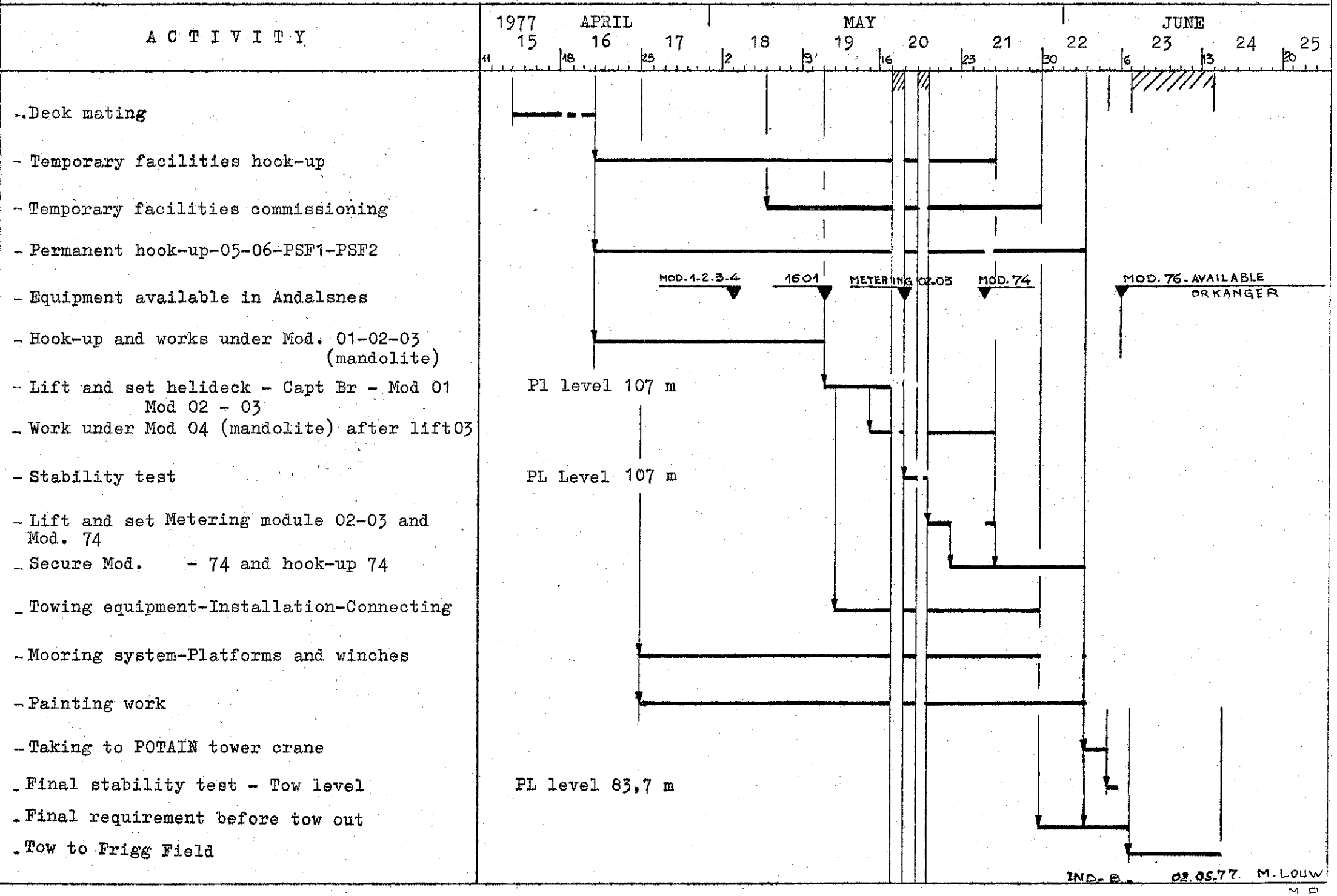
TCP2 PLANNING OVERALL COORDINATION

DRAWN BY: DEMOUGLIE DATE: 07.12.1976
CHECKED BY: LOUW DATE: 07.12.1976
SCALE

FRIGG FIELD DEVELOPMENT PROJECT

140 E20028 — 6

ELF NORGE - FRIGG FIELD - TCP2 PLATFORM - IN FJORD PLANNING -



TCP.2 - WEIGHT OF THE EQUIPMENT LOADED ON SUPPORT FRAME BEFORE DECK MATING

METRIC TONS

DESCRIPTION	TEMPORARY EQUIPMENT	PERMANENT EQUIPMENT
- Hook-up module 62	102	
- Winch RB 150 on 69	60	
- Manitowoc crane on 69	190	
- Grout spread 42	300	
- Grout equipment 43	80	
- Equipment module 67	270	
- Service module 64	204	
- Storage deck 41	100	
- Winch RB 150 on 41	80	
- Accommodation module 68 without helideck	550	
- Accommodation module 72	170	
- SYMINEX platform on 62	20	

TCP.2 - WEIGHT OF THE EQUIPMENT LOADED ON SUPPORT FRAME BEFORE DECK MATING

METRIC TONS

DESCRIPTION	TEMPORARY EQUIPMENT	PERMANENT EQUIPMENT
- Treatment pancake 05		290
- Treatment pancake 08		370
- Treatment pancake 09		350
- Pipe support frame 1		310
- Pipe support frame 2		110
- Treatment pancake 11		37
- Treatment pancake 12		30
- Treatment pancake 13		130
SUBTOTAL	2.126	1.627
TOTAL	3.753	
- Support frame with equipment from CHERBOURG	4.920	
- Support frame with equipment ready for deck mating	8.673	

TCP.2 - WEIGHT OF THE EQUIPMENT LOADED ON SUPPORT FRAME AFTER DECK MATING

METRIC TONS

DESCRIPTION	TEMPORARY EQUIPMENT	PERMANENT EQUIPMENT
- Captain bridge	70	
- Power pack on 41	10	
- Boats and life raft on temporary walk-way	20	
- Helideck on 68 module	155	
- NORCON winches for towing	30	
- Mooring system	100	
- Drilling equipment	30	
- Accommodation module 74	290	
- Hook up and M.D.H. equipment on 41	35	
- Hook up and M.D.H. equipment in 62	100	
- Diesel in 67 module	100	
- Water in 64 module	100	
- Cement in 42 module	75	

TCP.2 - WEIGHT OF THE EQUIPMENT LOADED ON SUPPORT FRAME AFTER DECK MATING.

DESCRIPTION	TEMPORARY EQUIPMENT	PERMANENT EQUIPMENT
- Treatment module 01		670
- Treatment module 02		1.150
- Gas metering on 02 module		120
- Treatment module 03		840
- Gas metering on 03 module		50
SUBTOTAL	1.115	2.830
TOTAL	3.945	
- Total weight at head of the platform before tow out	8.673 + 3.945 = 12.618	

V BUDGET

ESTIMATED TOTAL COSTS FOR E. 10 ADDENDUM 10 - HOOK UP

	BUDGET Nkr	FINAL ESTIMATE COST Nkr
1. PERSONNEL		
1.1. NORWEGIAN CONTRACTORS ROSENBERG-KVAERNER		
1.1.1. STAFF		
ENGINEERS	5.500.000	4.750.000
SECRETARIES-CLERKS	500.000	350.000
TRAVEL EXPENSES	250.000	250.000
OFFICE EXPENSES	250.000	150.000
	6.500.000	5.500.000
1.1.2. LABOUR		
NORWEGIAN CONTRACTORS	10.700.000	14.000.000
ROSENBERG/KVAERNER	6.100.000	5.000.000
	16.800.000	19.000.000
1.2. SUBCONTRACTORS		
1.2.1. STAFF		
CHRISTIANI & NIELSEN	250.000	725.000
UIE/CMP	1.000.000	600.000
HDW	600.000	500.000
SPIE-B.-VIGOR	300.000	275.000
OTHERS	250.000	-
	2.400.000	2.100.000
1.2.2. LABOUR		
CHRISTIANI & NIELSEN	2.400.000	3.000.000
UIE/CMP	3.900.000	4.500.000
HDW	3.300.000	3.800.000
SPIE-B.-VIGOR	1.950.000	3.100.000
METODE/MIKKOLSEN	520.000	600.000
OTHERS	910.000	-
	12.980.000	15.000.000

ESTIMATED TOTAL COSTS FOR E. 10 ADDENDUM 10 - HOOK UP

1.2.3. MOB/DEMOB HDW-UIE/CMP	1.020.000	1.650.000
NORCON FEE ON 1.2.	1.640.000	1.875.000
2. SERVICES TO SUBCONTRACTORS		
2.1. ACCOMMODATION	300.000	200.000
2.2. CATERING	420.000	800.000
2.3. HANDTOOLS	590.000	200.000
2.4. PROTECTIVE CLOTHING	400.000	125.000
	1.710.000	1.325.000
3. EQUIPMENT		
3.1. MOB/DEMOB		
MOB/DEMOB NC EQUIPMENT	960.000	400.000
MOB/DEMOB KV EQUIPMENT	650.000	300.000
MOB/DEMOB 2 ADD CAMPS	920.000	600.000
CAMPS 5 & 6	175.000	150.000
HOOK UP OF POWER TO PLATFORM	675.000	250.000
	3.380.000	1.700.000
3.2. EQUIPMENT ON WK BASIS		
EQUIPMENT ON WEEKLY RATES		4.250.000
EQUIPMENT ON HOURLY RATES		2.750.000
C & N SUPPLIES, PLANT, EQUIP.		1.000.000
MISCELLANEOUS SUPPLIES		1.200.000
PERSONNEL TRANSPORT ONSHORE		50.000
MATERIALS, CONSUMMABLES, DIESEL OIL, ETC...		1.500.000
	10.175.000	10.750.000
TOTAL EQUIPMENT	13.555.000	12.450.000
TOTAL 1 + 2 + 3	56.605.000	58.900.000
CONTINGENCY	5.395.000	3.000.000*
GRAND TOTAL	62.000.000	61.900.000

* CONTINGENCY (5%)

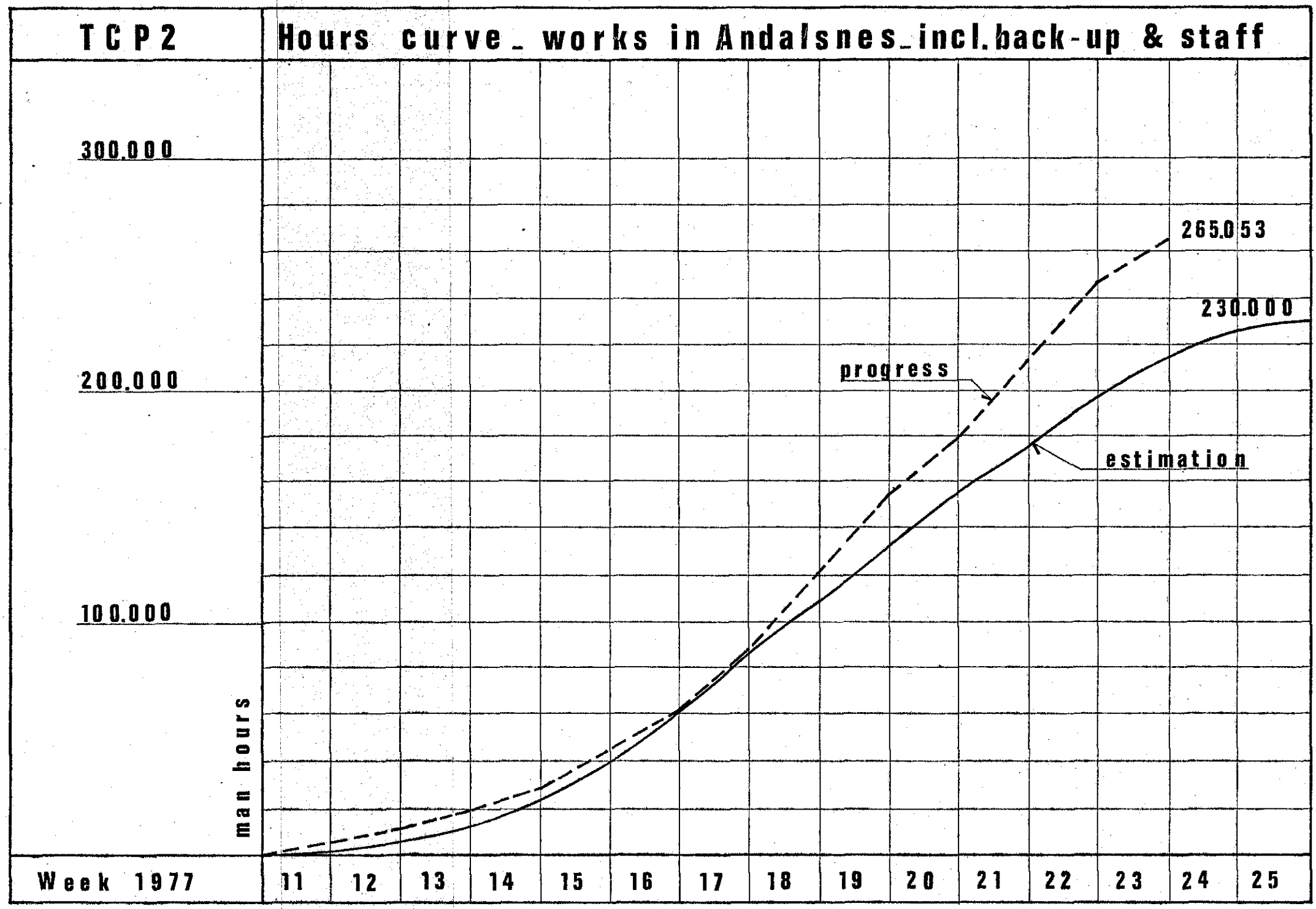
H O O K U P M A N H O U R S				
CONTRACTORS & SUBCONTRACTORS	LABOUR (INC. FOREMEN)		STAFF*	TOTAL
	BUDGET	ACTUAL		
NORWEGIAN CONTRACTORS SCAFFOLDING AND PRODUCTION	78.000	42.138	18.982	141.118
BACK UP ONSHORE AND STRUCTURE		49.521		
ROSENBERG VERFT AND KVAERNER	37.000	30.477		
CHRISTIANI & NIELSEN CANTEEN LABOUR (For subcontractors labour)	20.000	9.520	4.557	30.427
HOOK UP INCL END OF E. 30 CONTRACT		16.350		
UNION INDUSTRIELLE ET D'ENTREPRISE CONSTRUCTIONS METALLIQUES DE PROVENCE	30.000	31.926	6.240	38.166
HOWALDTWERKE DEUTSCHE WERFT	22.000	27.400	2.327	29.727
SPIE BATIGNOLLES VIGOR	15.000	18.870	1.530	20.400
METODE/MIKKOLSEN (PAINTING)	4.000	5.215	-	5.215
VARIOUS	7.000	-	-	-
AARONITE FOR MEMORY NOT UNDER E. 10 ADD 10 CONTRACT (1414 MAN HOURS)	-	-	-	-
TOTAL	213.000	231.417	33.636	265.053

* 48 hrs/week for Norcon/RV
60 hrs/week for other staff

BALANCE OF MANHOURS

BETWEEN TEMPORARY AND PERMANENT EQUIPMENT

	TEMPORARY EQUIPMENT	PERMANENT EQUIPMENT
NORCON (Scaffolding)	18.593	23.545
R/V	26.877	3.600
C/N	14.850	1.500
UIE/CMP	3.000	28.926
SBV	-	18.870
HDW	27.400	-
METODE	5.215	-
TOTAL LABOUR	95.935	76.441
BACK UP		
NORCON ONSHORE AND STRUCTURE	49.521	-
CHRISTIANI & NIELSEN (CANTEEN)	9.520	-
TOTAL BACK UP	59.041	-
STAFF		
NORCON/RV	16.502	2.480
C/N	4.307	250
UIE/CMP	1.000	5.240
HDW	2.327	-
SPIE	-	1.530
TOTAL STAFF	24.136	9.500
GRAND TOTAL (MAN HOURS)	179.112	85.941


TCP2
Hours curve_ works in Andalsnes_incl.back-up & staff
300.000
200.000
100.000
man hours
265.053
230.000
progress
estimation
Week 1977
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

VI PROGRESS REPORT