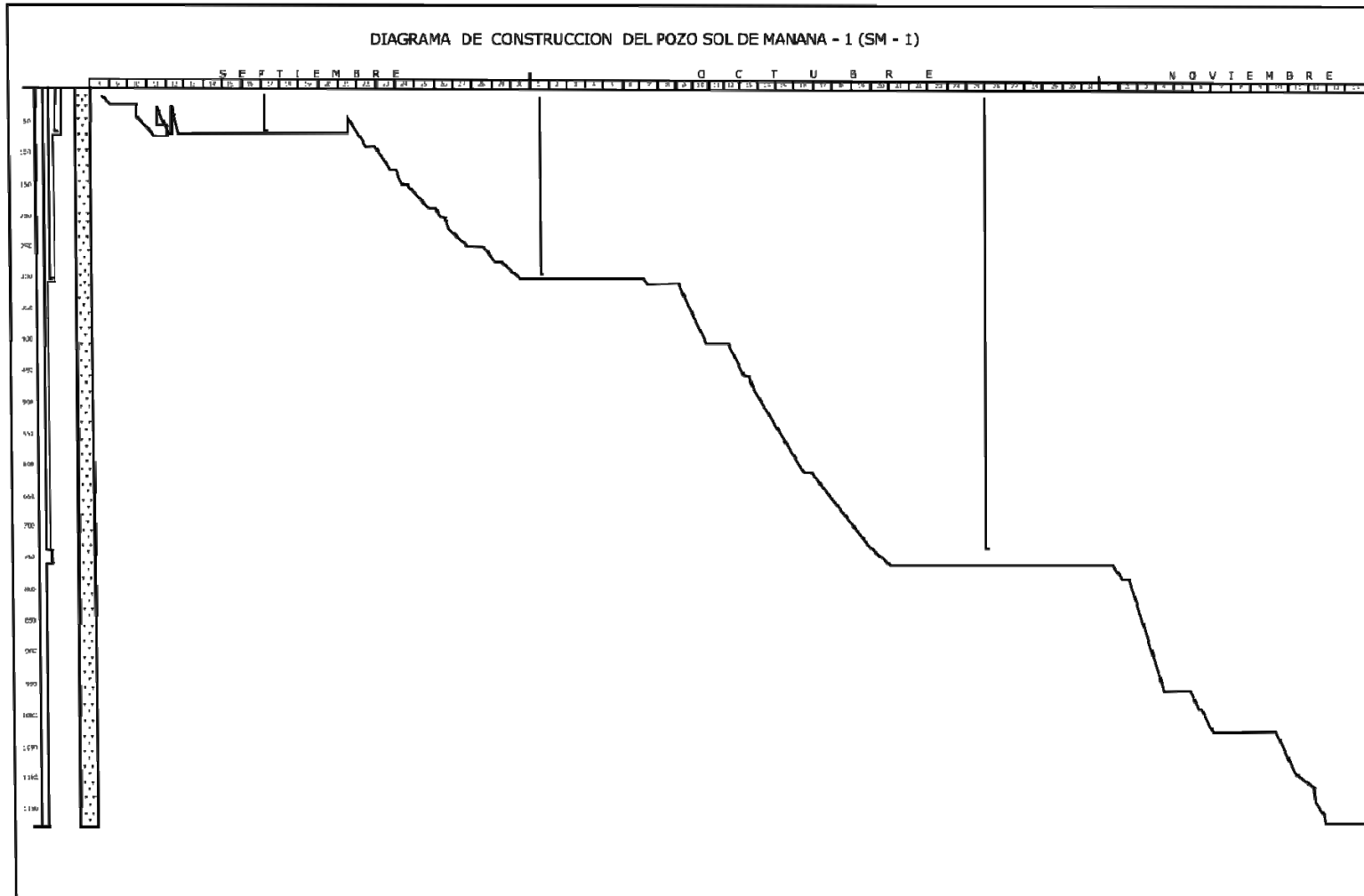
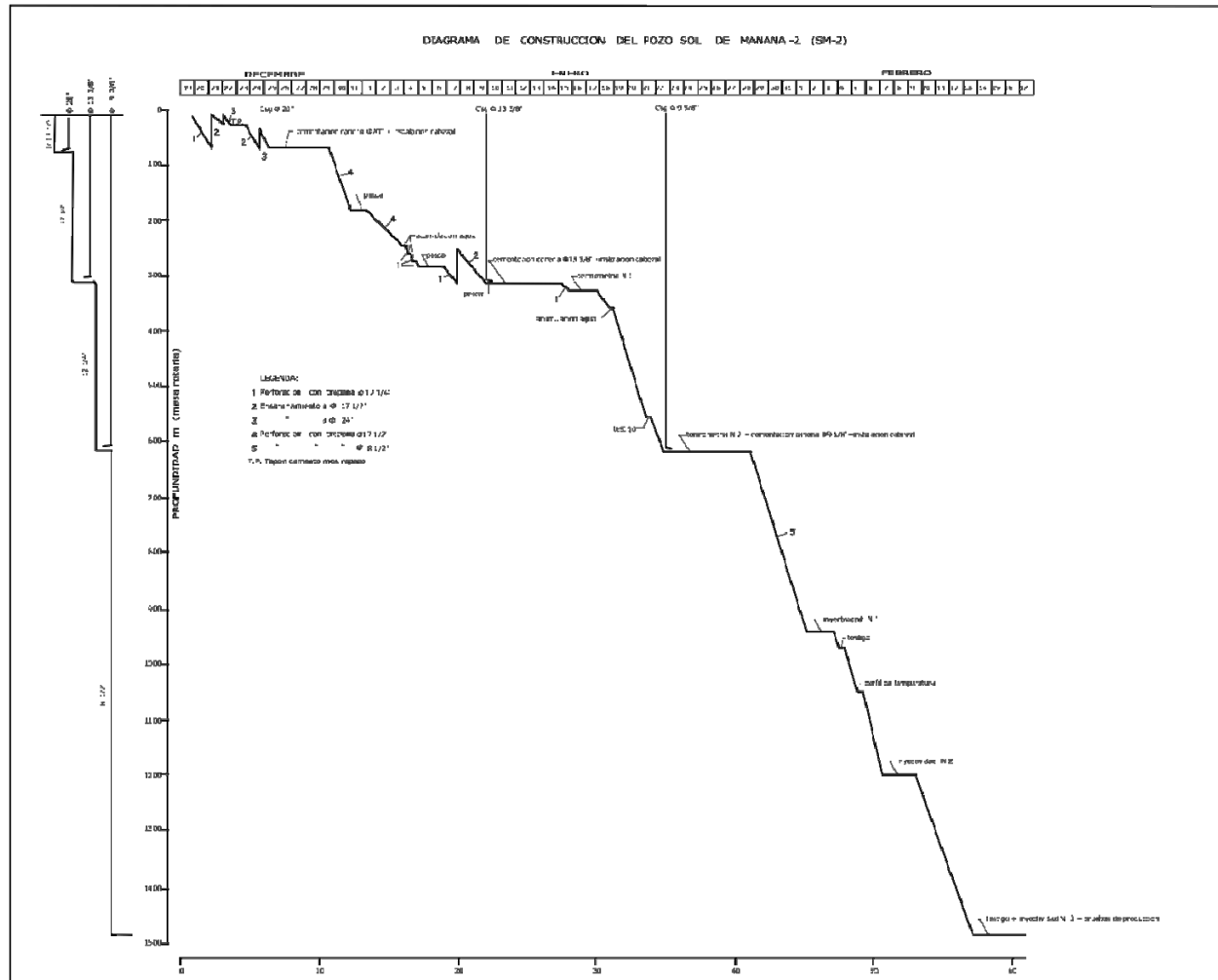


添付資料

## Appendix-1 ドリリングチャート

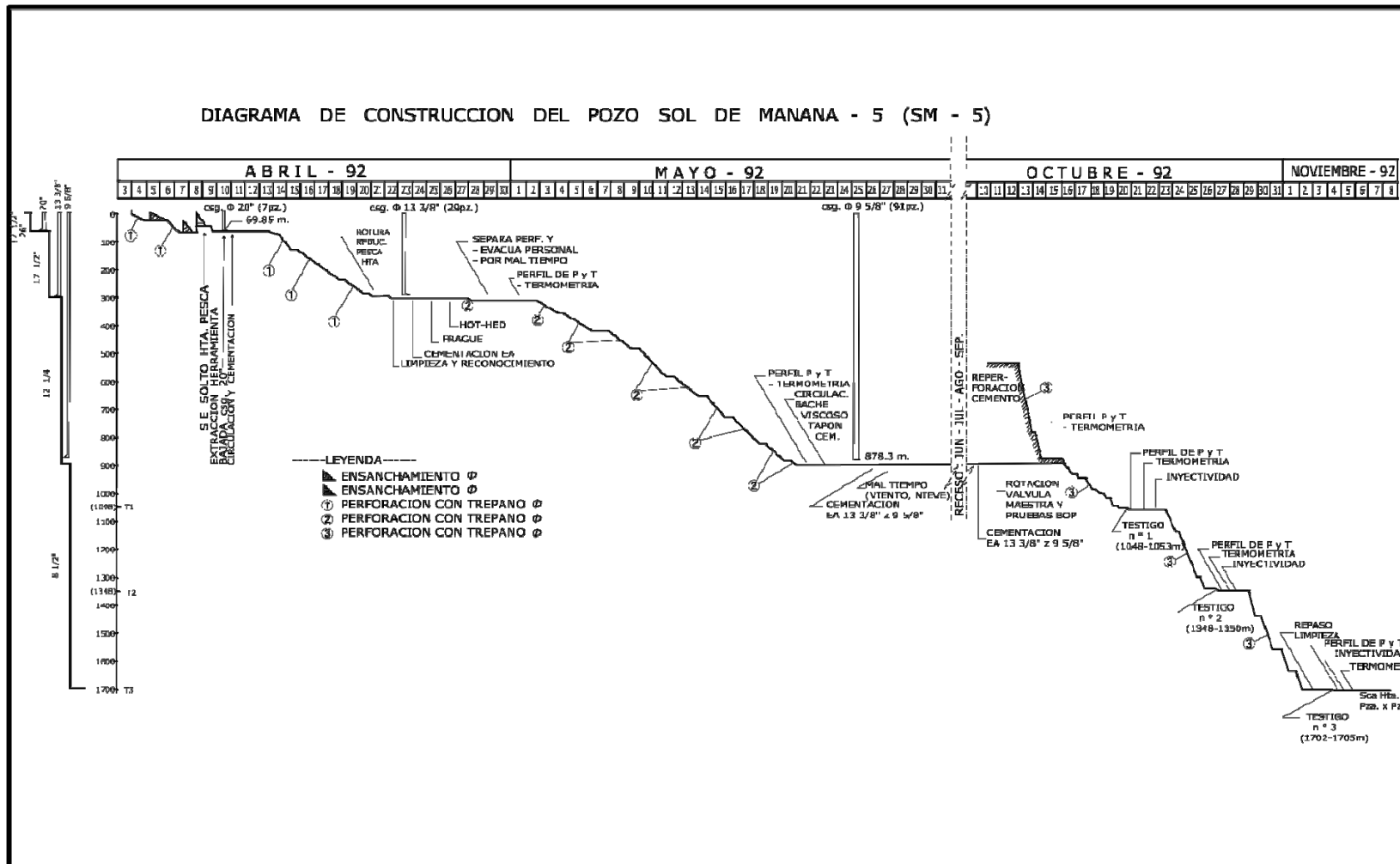








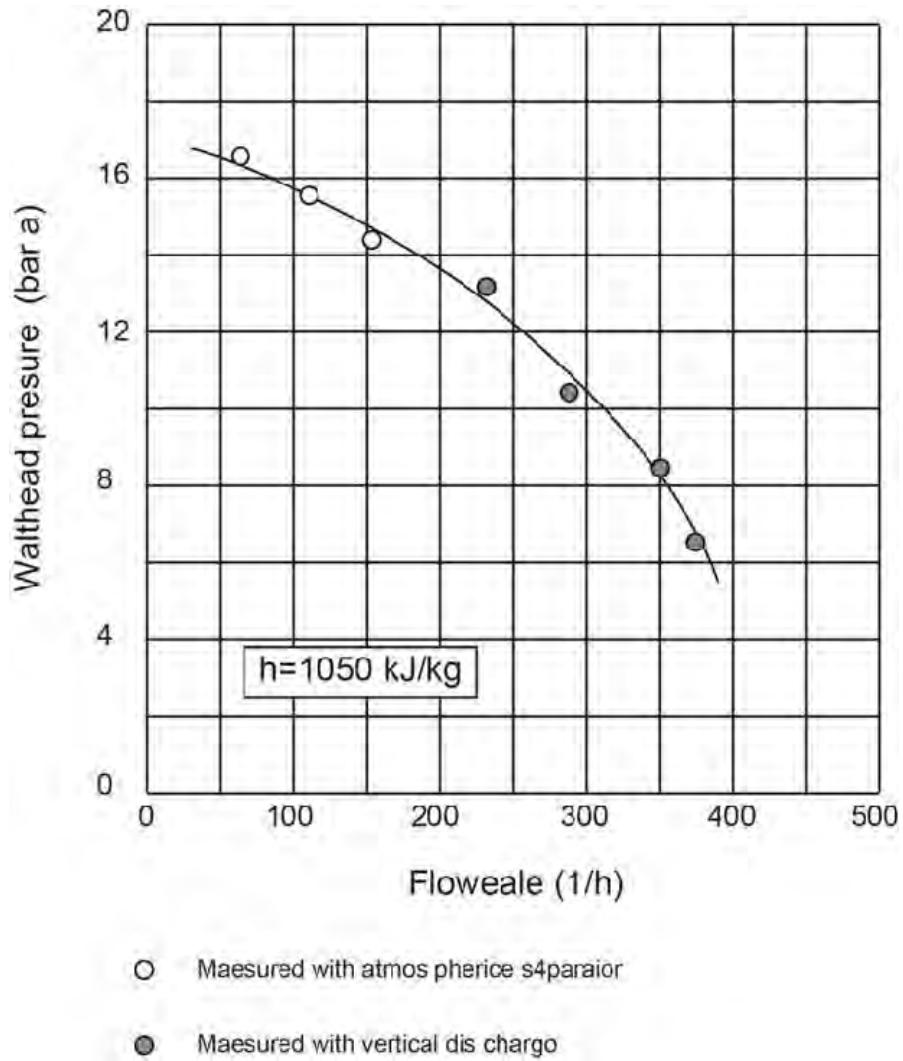






## Appendix-2 噴気試験結果

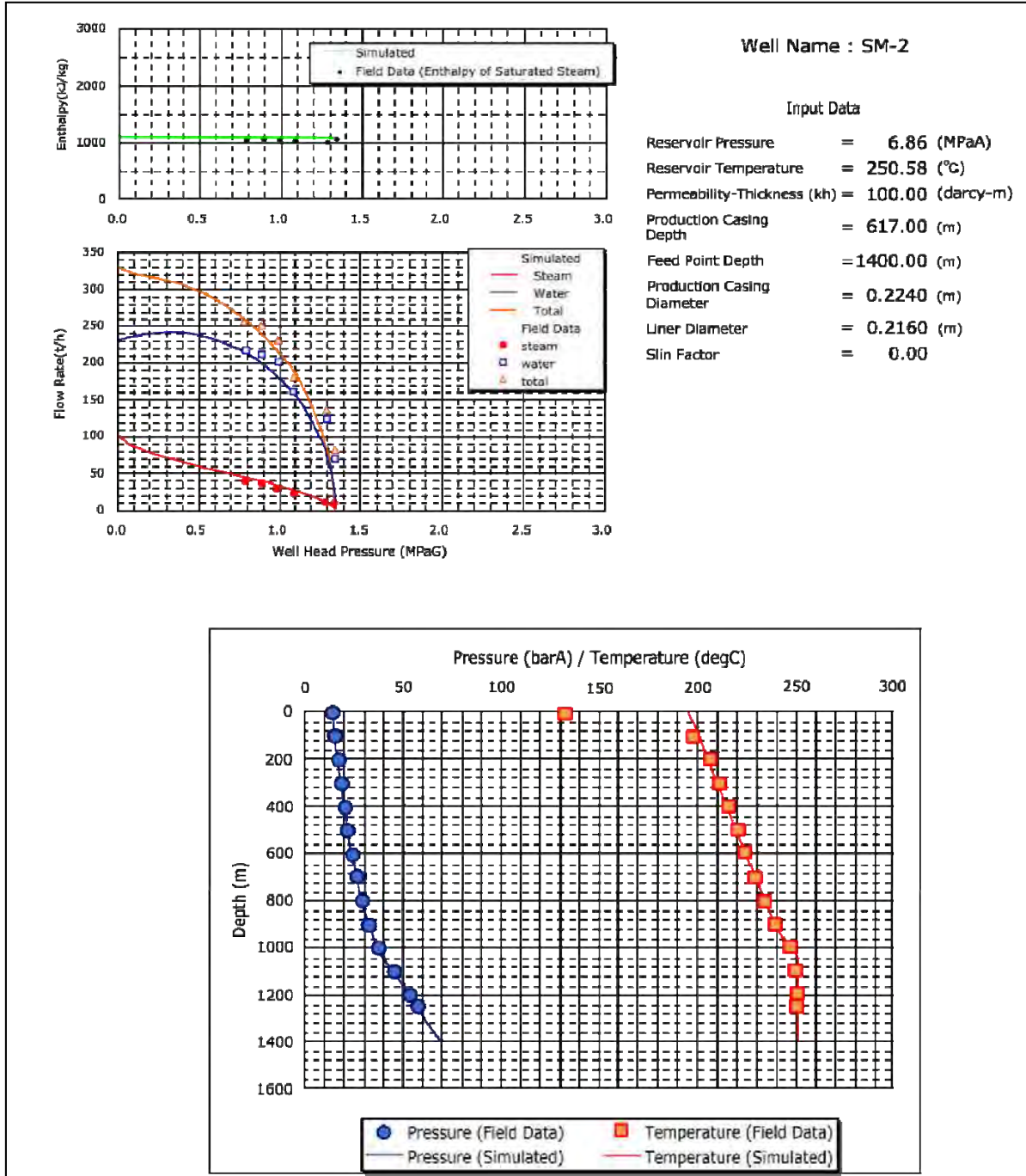
● 1987年 - 1990年



出典：JETRO（2008）をもとに調査団作成

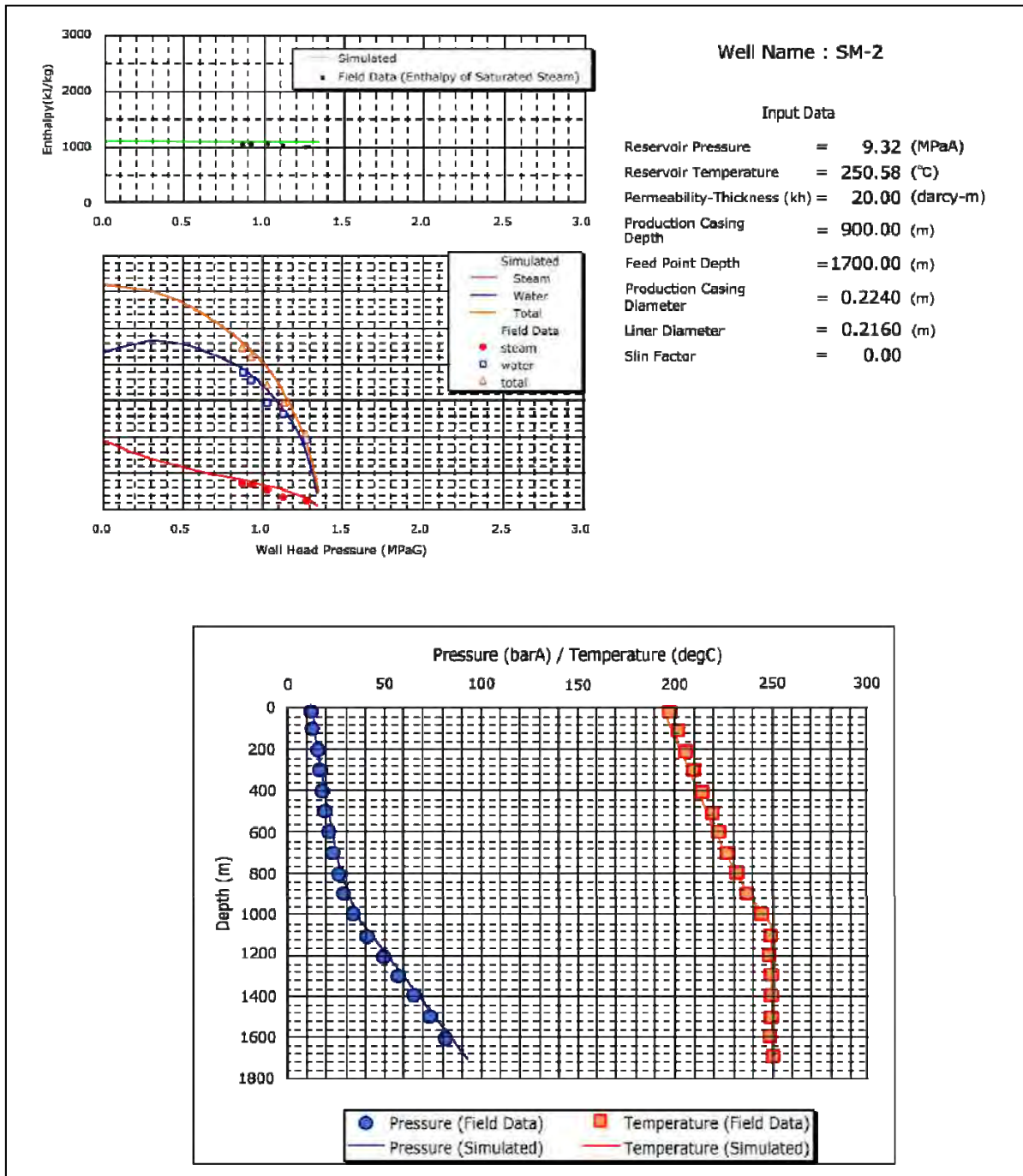
図 AP2-1 SM-1 噴気特性試験結果

● 1997年5 - 8月



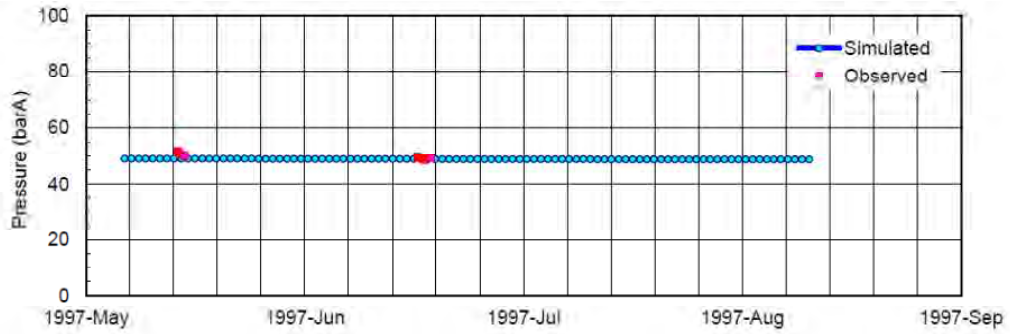
出典：JETRO（2008）をもとに調査団作成

図 AP2-2 SM-2 噴気特性試験解析結果（1997年）



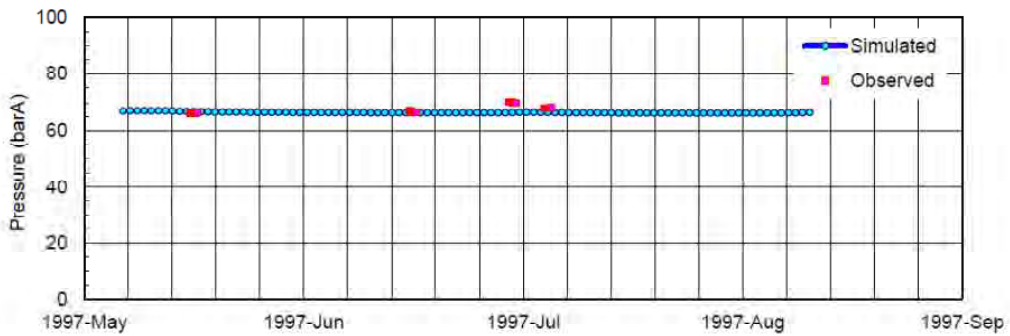
出典：JETRO（2008）をもとに調査団作成

図 AP2-3 SM-5 噴気特性試験解析結果（1997 年）



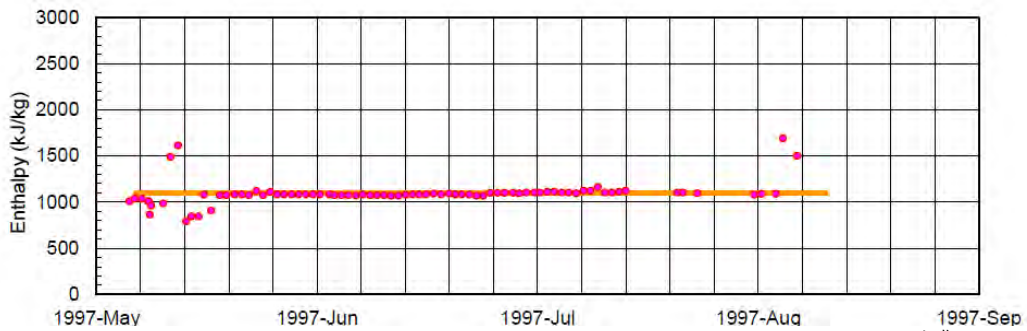
出典：JICA (2013)

図 AP2-4 SM-1 坑井内圧力測定結果 (1997 年)



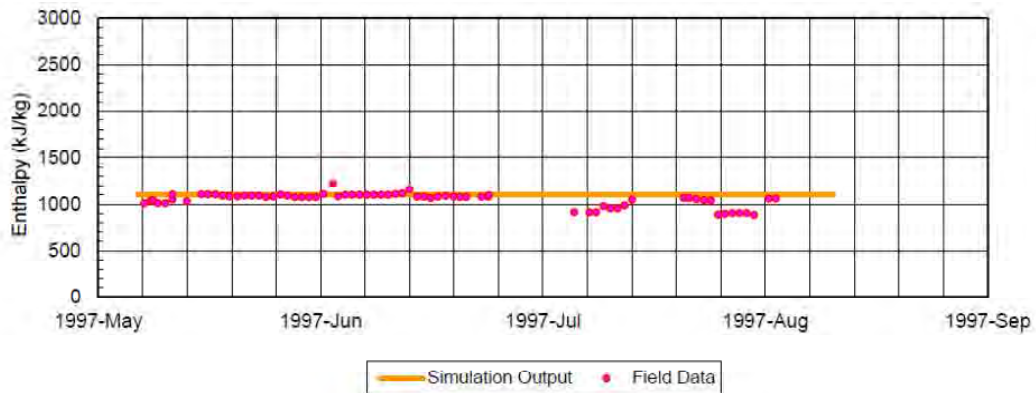
出典：JICA (2013)

図 AP2-5 SM-3 坑井内圧力測定結果 (1997 年)



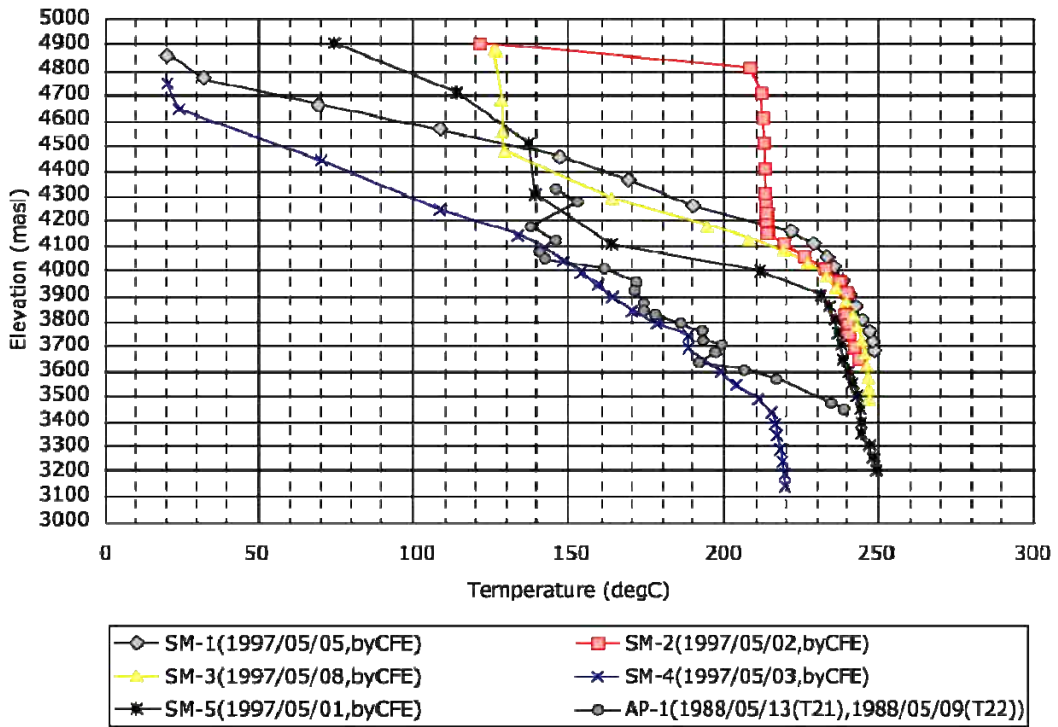
出典：JICA (2013)

図 AP2-6 SM-2 比エンタルピ測定結果 (1997 年)



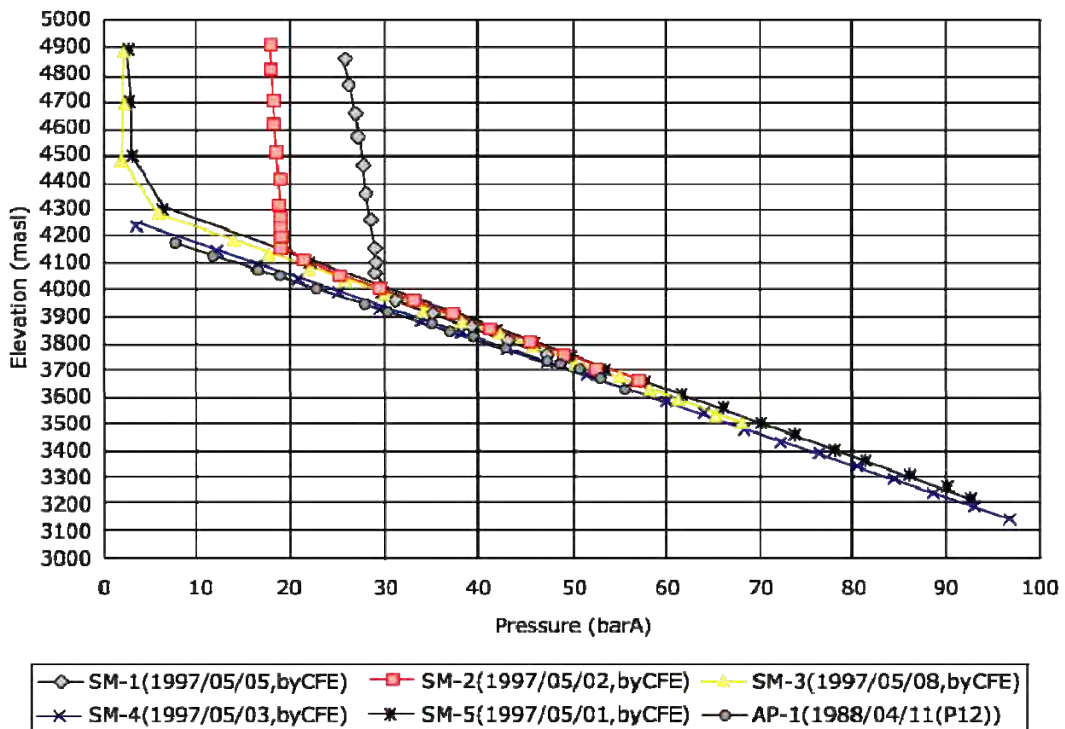
出典：JICA (2013)

図 AP2-7 SM-5 比エンタルピ測定結果 (1997 年)



出典：JETRO（2008）をもとに調査団作成

図 AP2-8 各坑井の静止中坑井内温度測定結果[1997年（AP-1のみ1988年）]



出典：JETRO（2008）をもとに調査団作成

図 AP2-9 各坑井の静止中坑井内圧力測定結果[1997年（AP-1のみ1988年）]

● 2012年12月 - 2013年4月

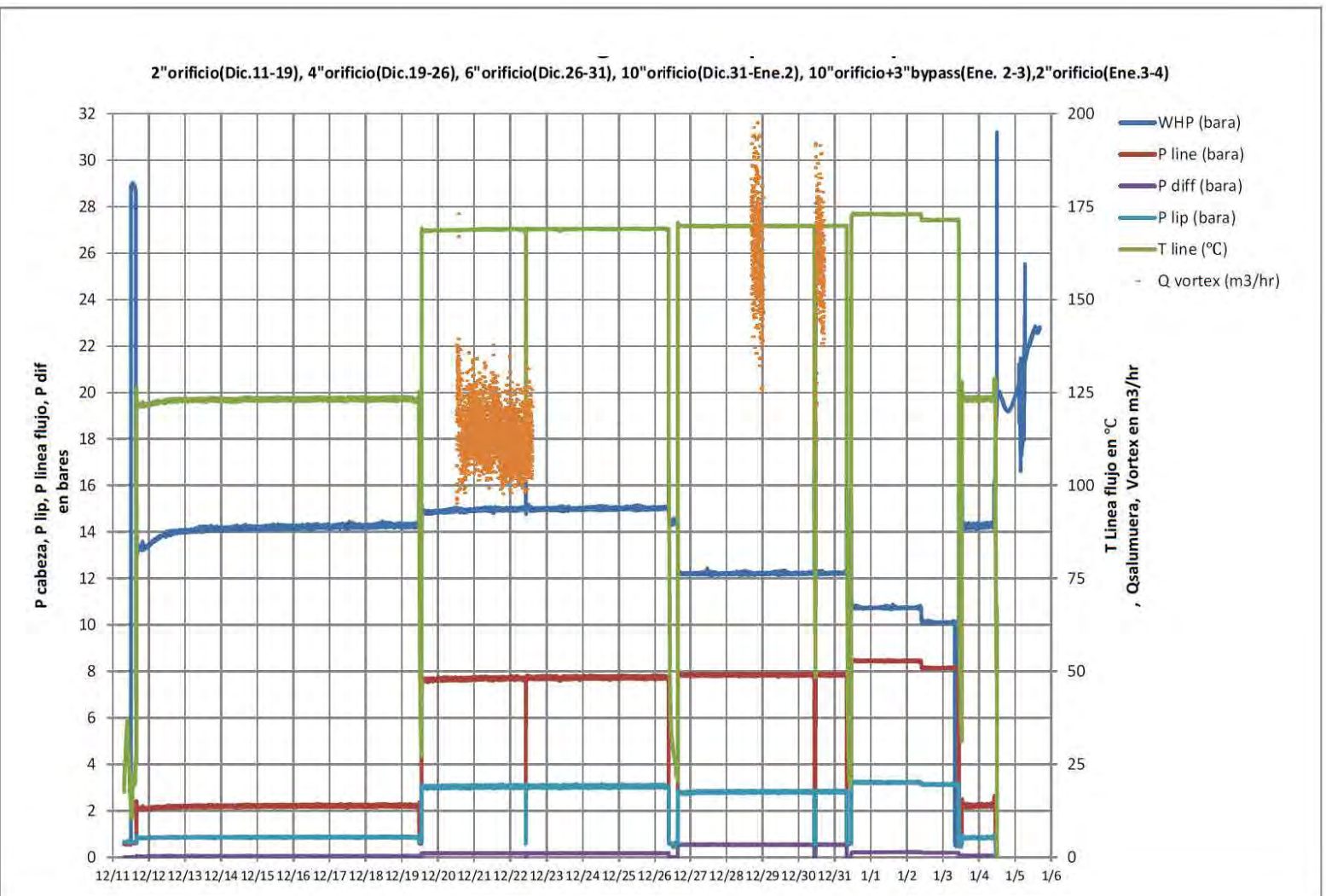


図 AP2-10 SM-1の噴気特性試験結果（2012年12月 - 2013年1月） 出典：JICA（2013）

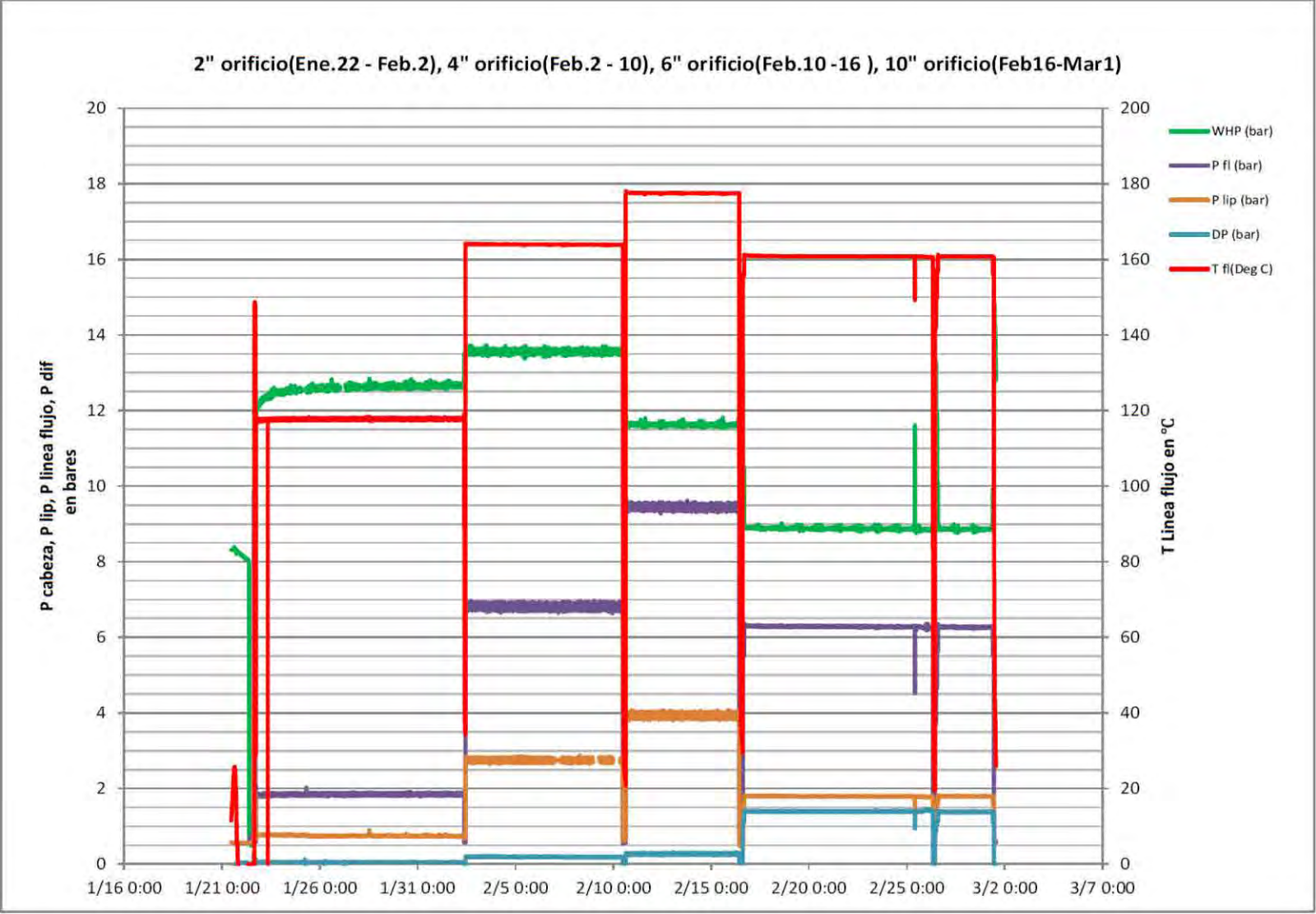


図 AP2-11 SM-3 の噴気特性試験結果（2013年1-2月）

出典：JICA（2013）



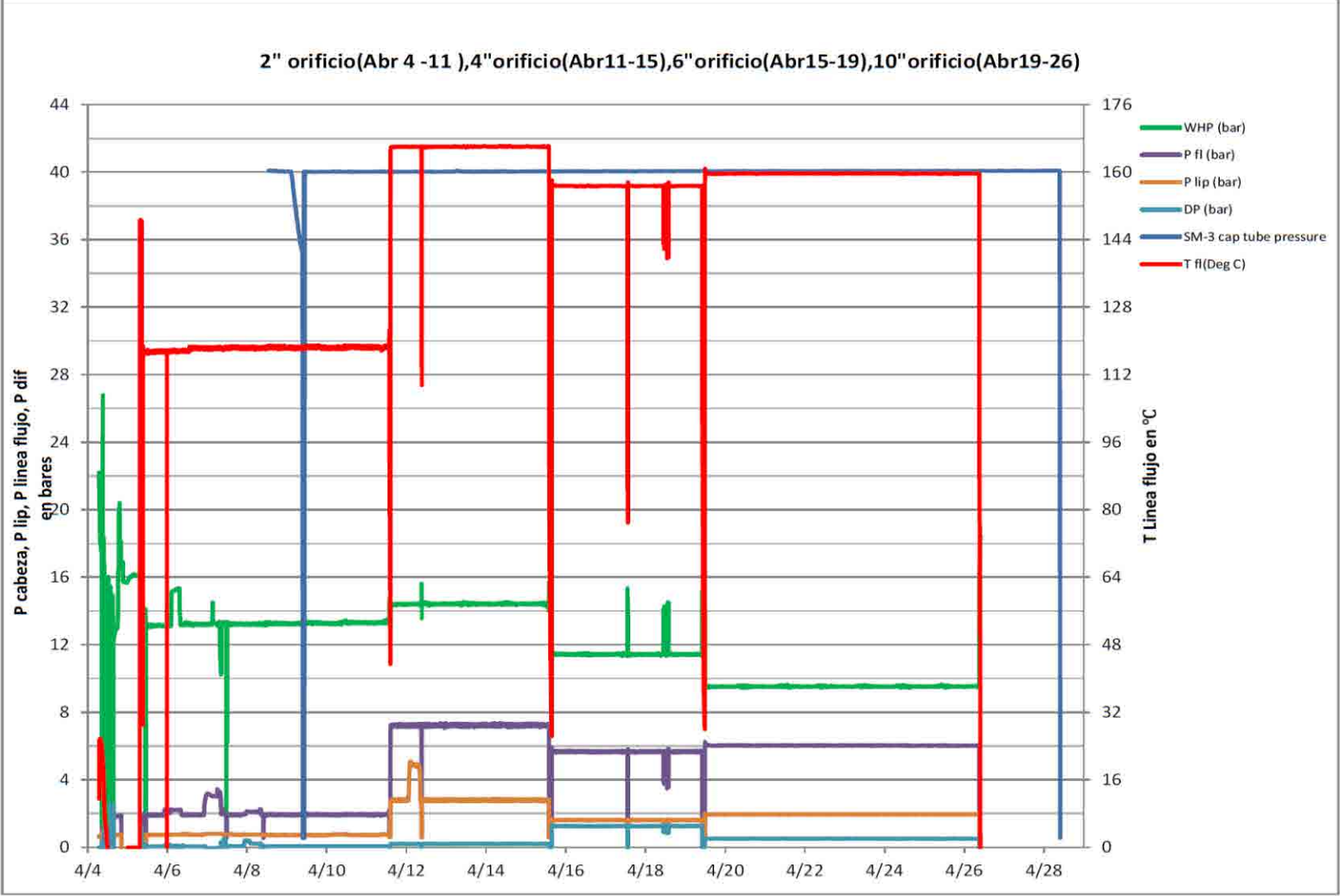
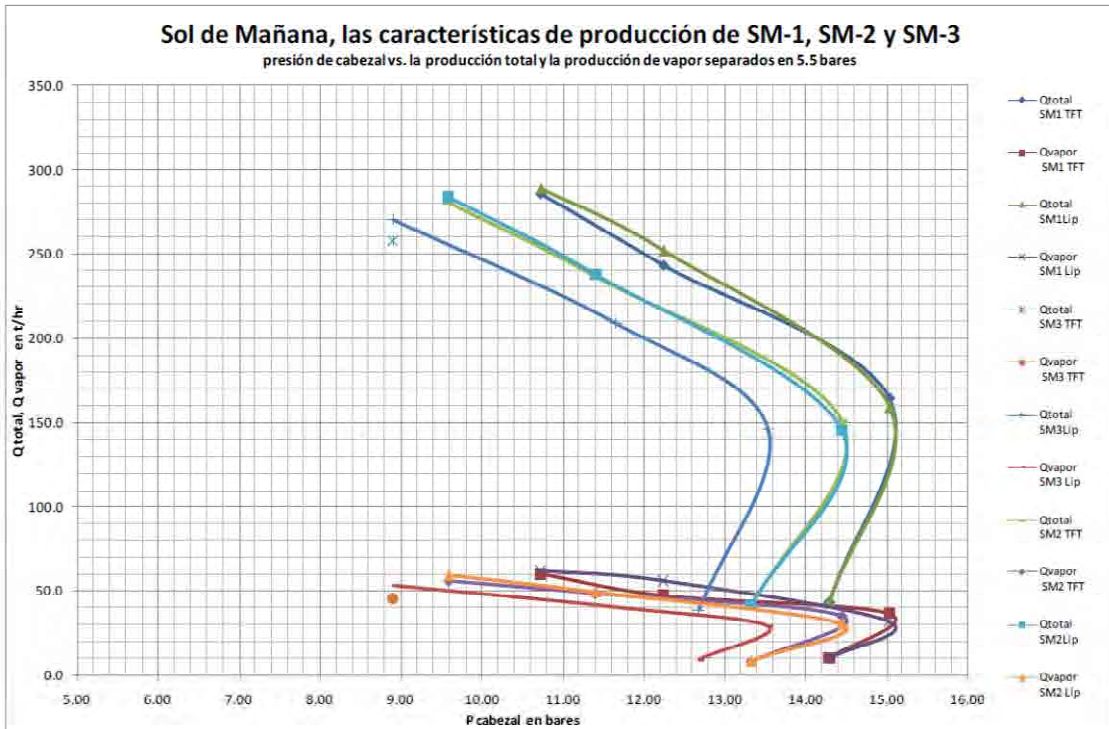


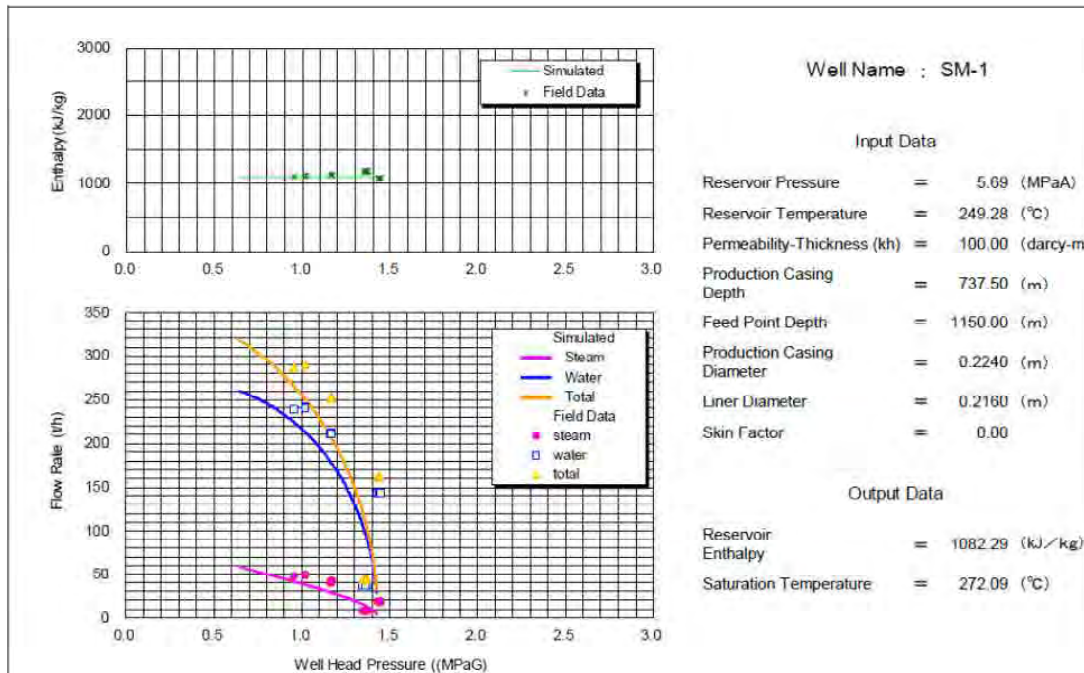
図 AP2-12 SM-2の噴気特性試験結果（2013年4月）

出典：JICA（2013）



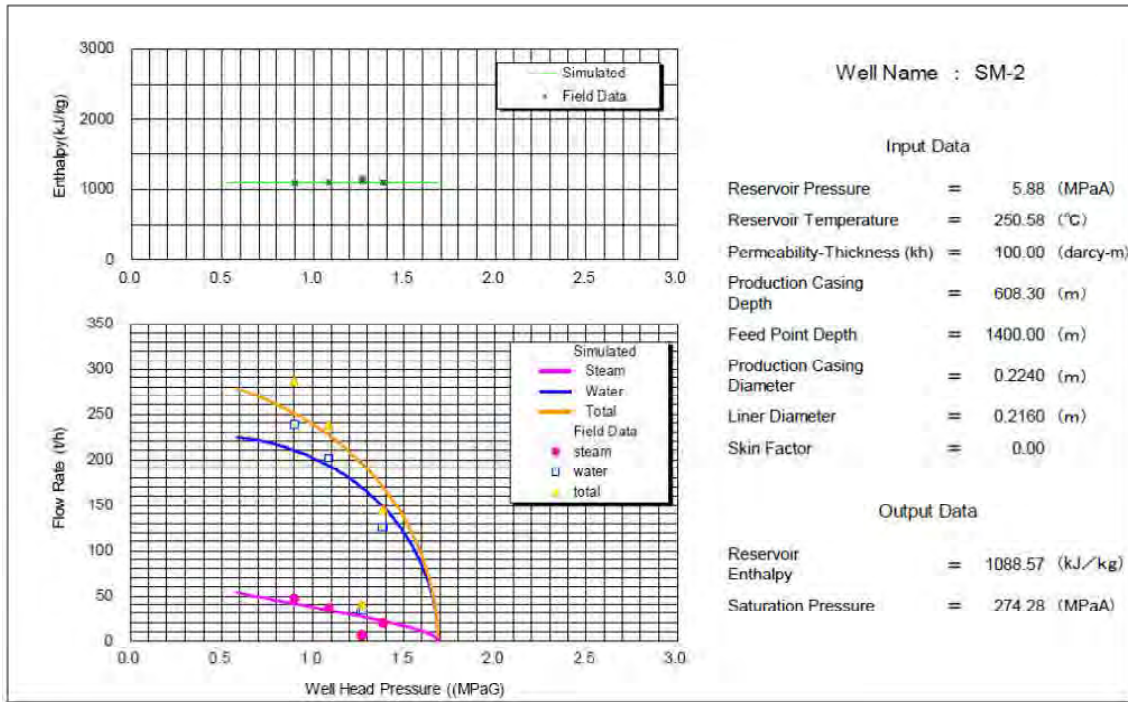
出典：JICA (2013)

図 AP2-13 SM-1、SM-2、SM-3 の噴気特性試験結果の比較 (2012年12月 - 2013年4月)



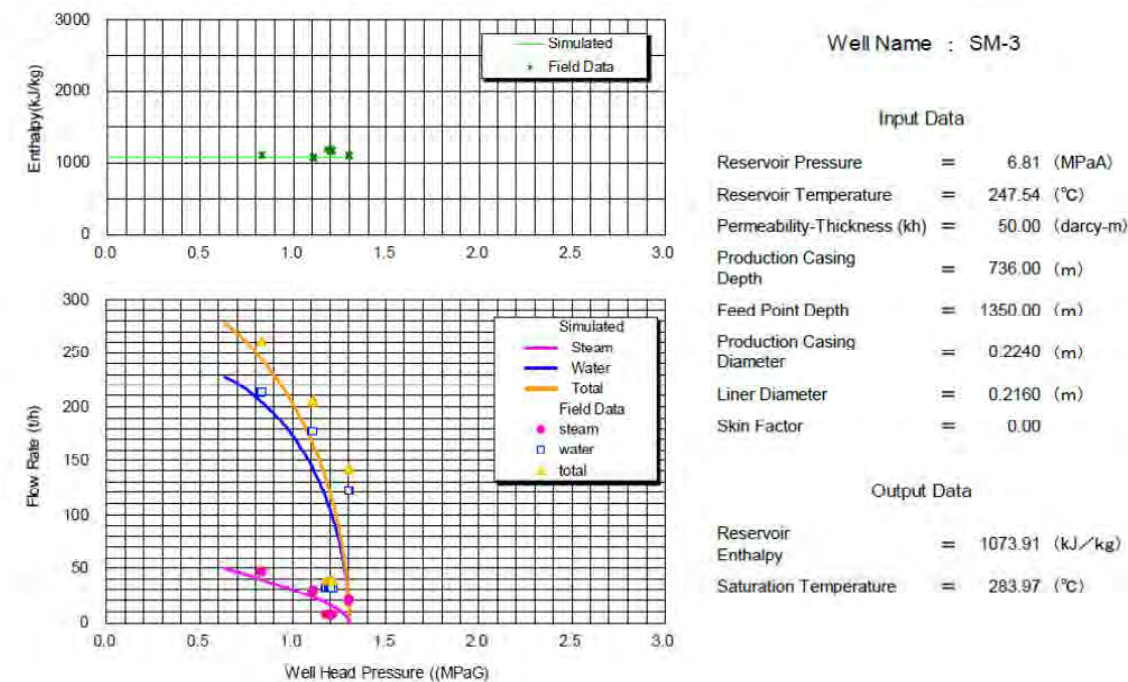
出典：JICA (2013)

図 AP2-14 SM-1 の噴気特性試験解析結果 (2013年)



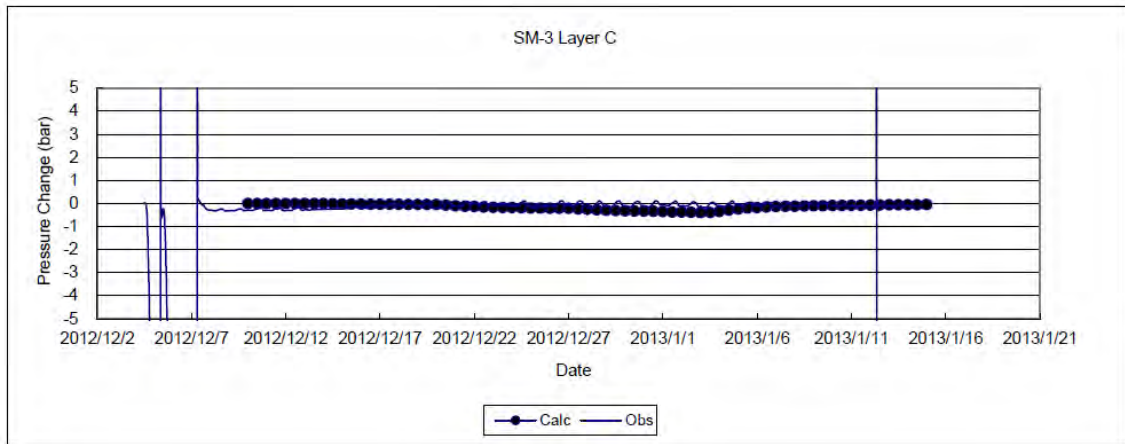
出典：JICA（2013）

図 AP2-15 SM-2 の噴気特性試験解析結果（2013年）



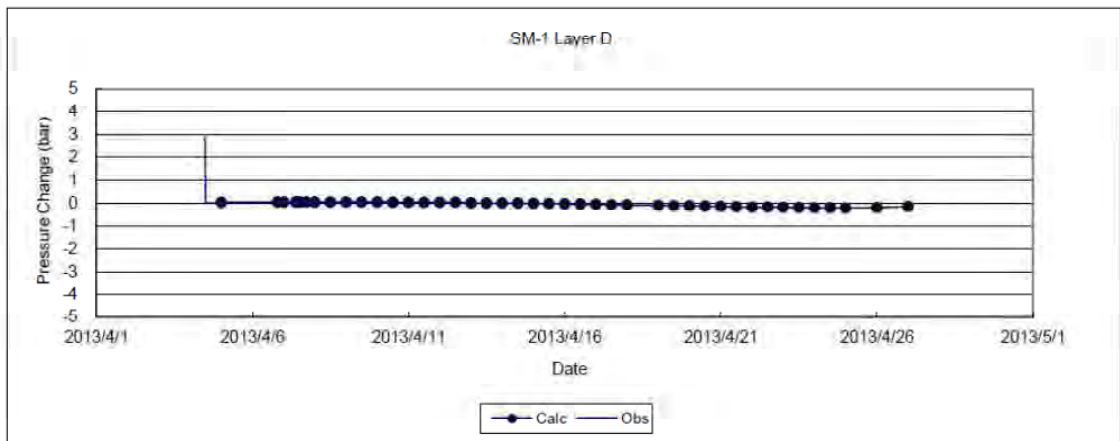
出典：JICA（2013）

図 AP2-16 SM-3 の噴気特性試験解析結果（2013年）



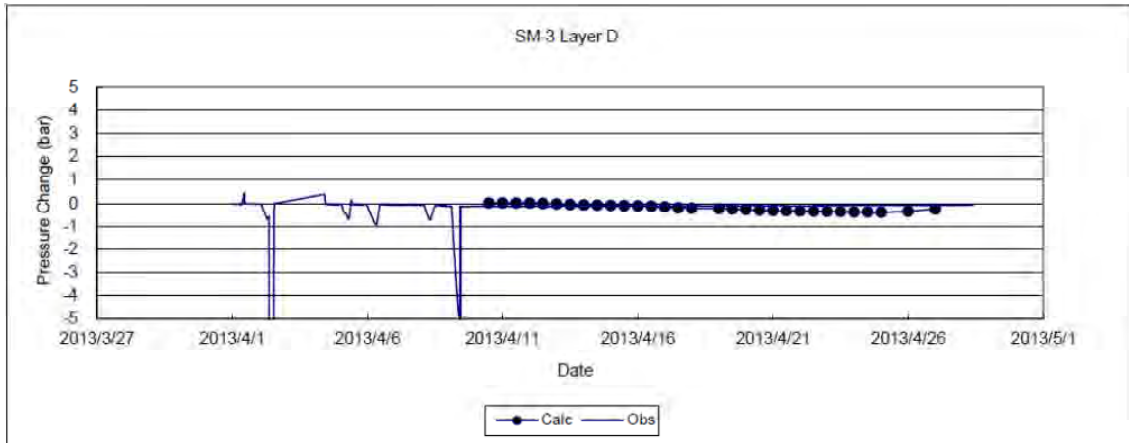
出典：JICA（2013）

図 AP2-17 SM-1 噴出中の SM-3 坑井内圧力測定結果（2012 年 12 月 - 2013 年 1 月）



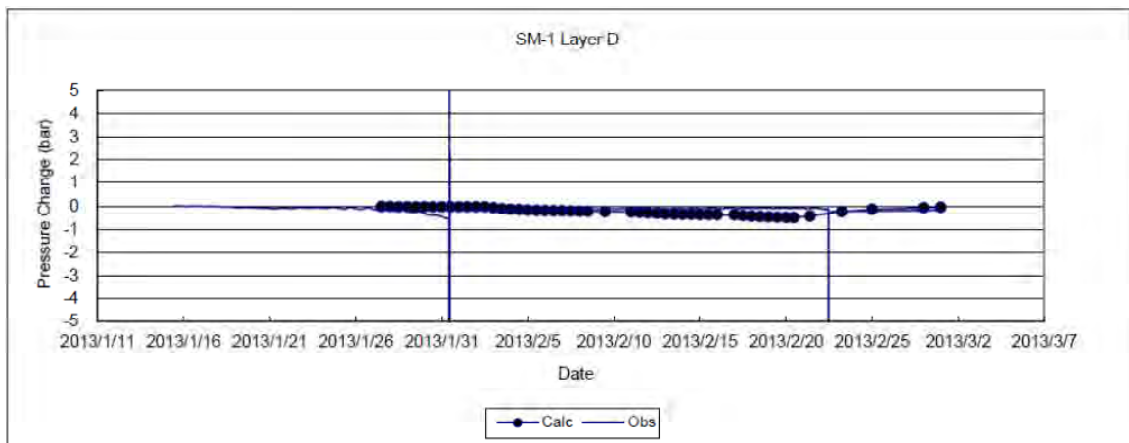
出典：JICA（2013）

図 AP2-18 SM-2 噴出中の SM-1 坑井内圧力測定結果（2013 年 4 月）



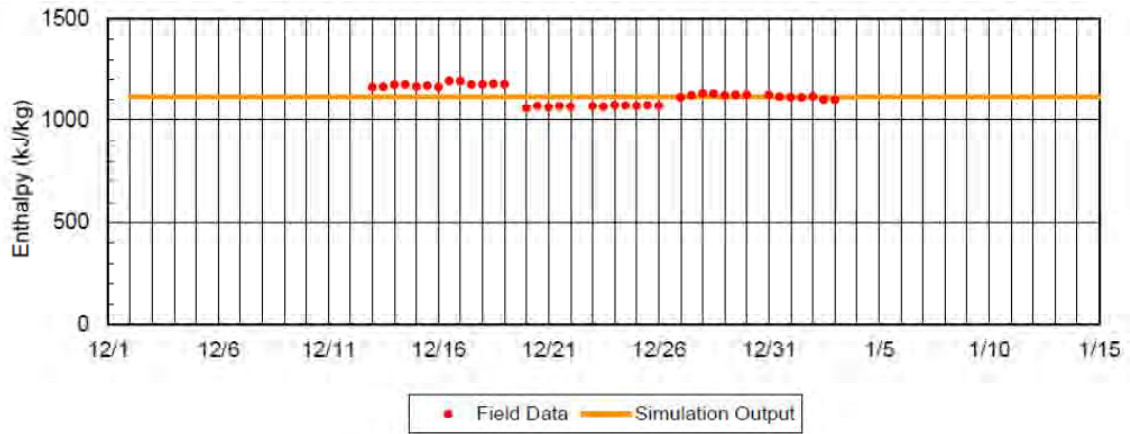
出典：JICA (2013)

図 AP2-19 SM-2 噴出中の SM-3 坑井内圧力測定結果 (2013 年 4 月)



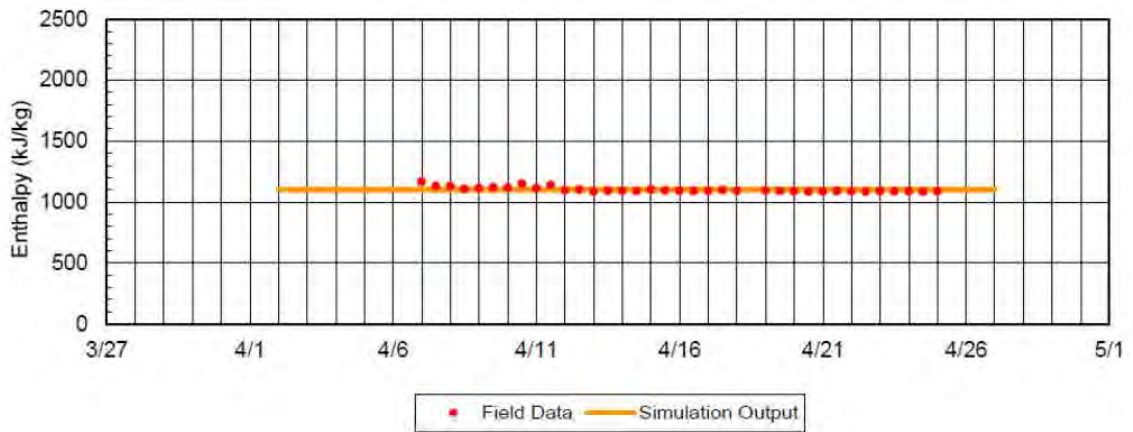
出典：JICA (2013)

図 AP2-20 SM-3 噴出中の SM-1 坑井内圧力測定結果 (2013 年 1 - 3 月)



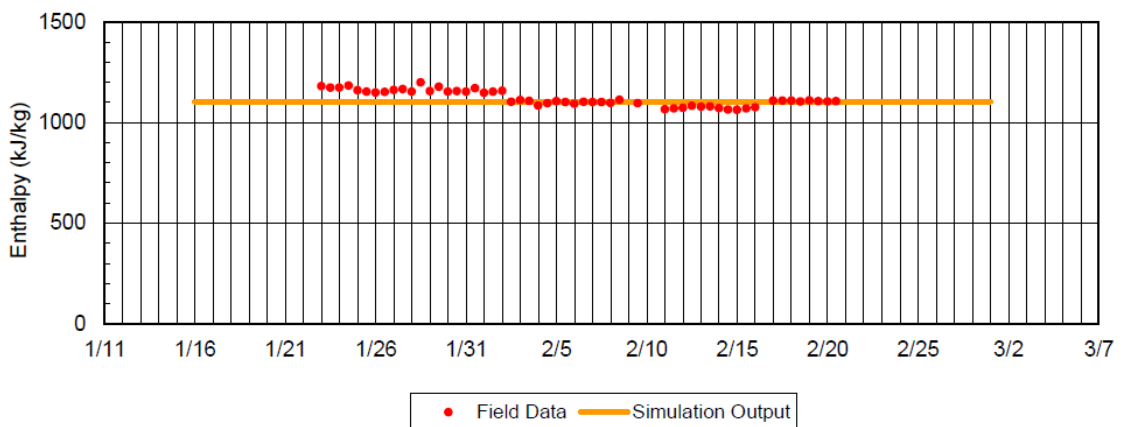
出典：JICA（2013）

図 AP2-21 SM-1 比エンタルピ測定結果（2012年12月 - 2013年1月）



出典：JICA（2013）

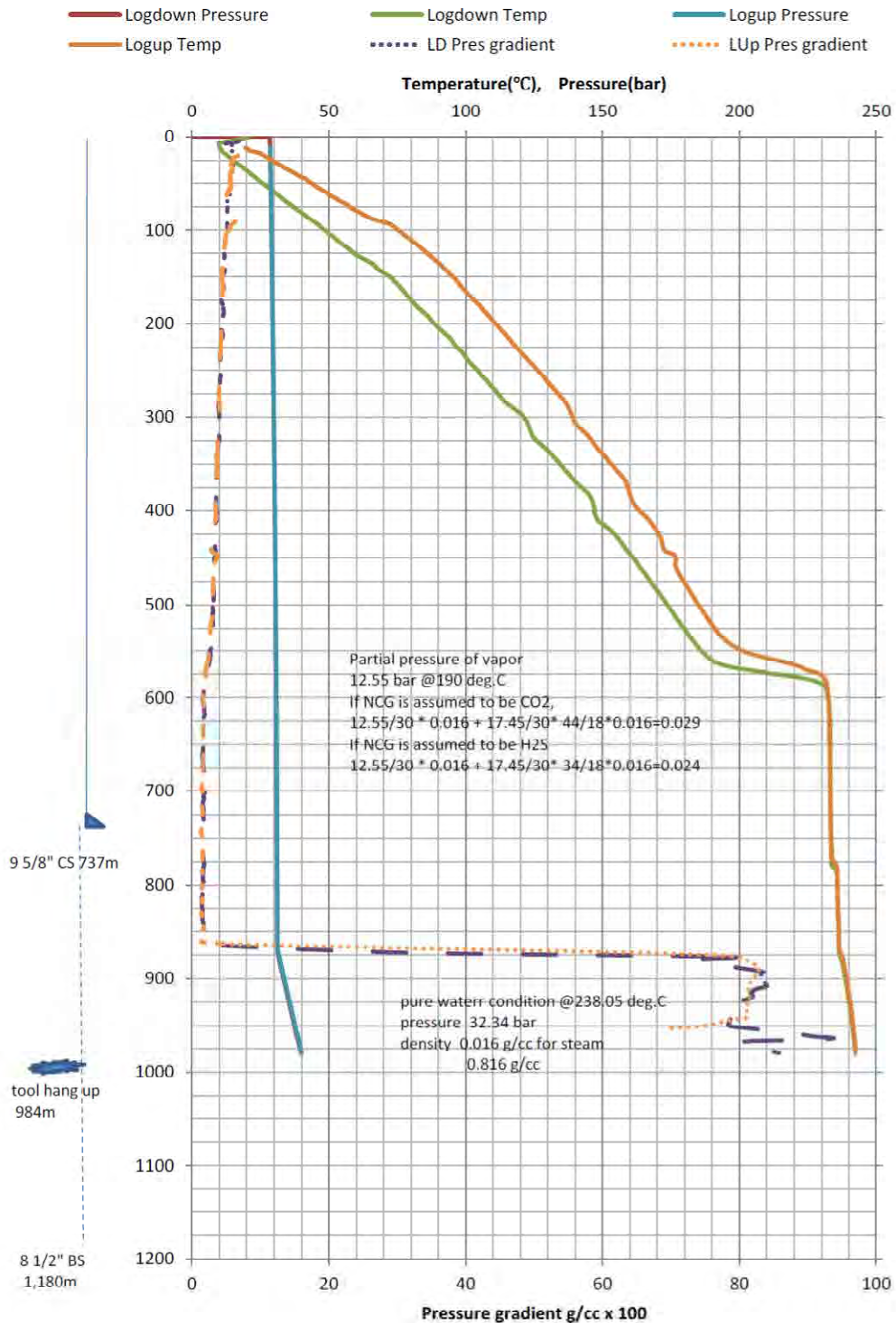
図 AP2-22 SM-2 比エンタルピ測定結果（2013年4月）



出典：JICA（2013）

図 AP2-23 SM-1 比エンタルピ測定結果（2013年1 - 3月）

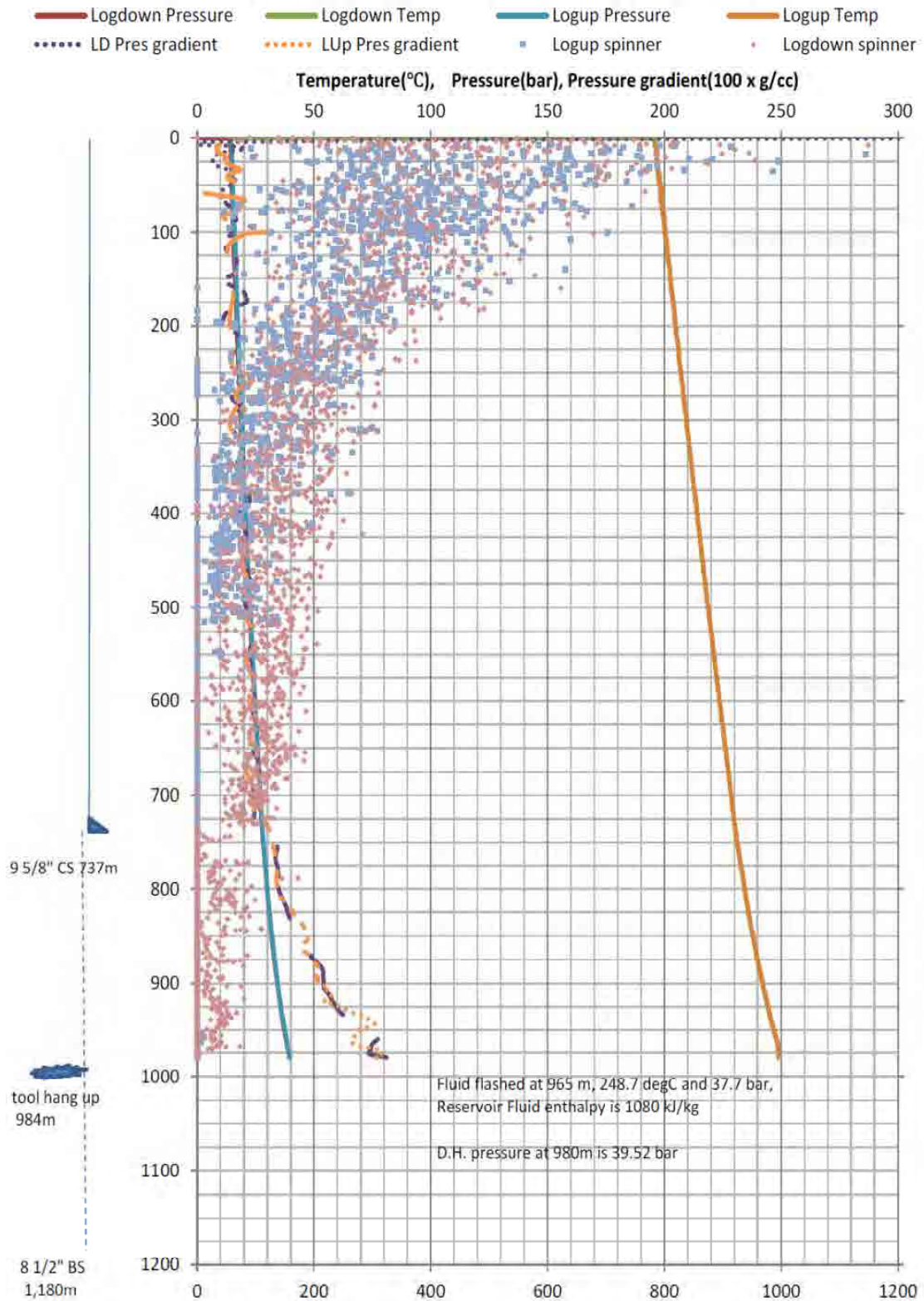
PT Static SM-1 Run1 05 December 2012



出典：JICA (2013)

図 AP2-24 SM-1 静止中 PT 検層結果 (2012 年 12 月 5 日実施)

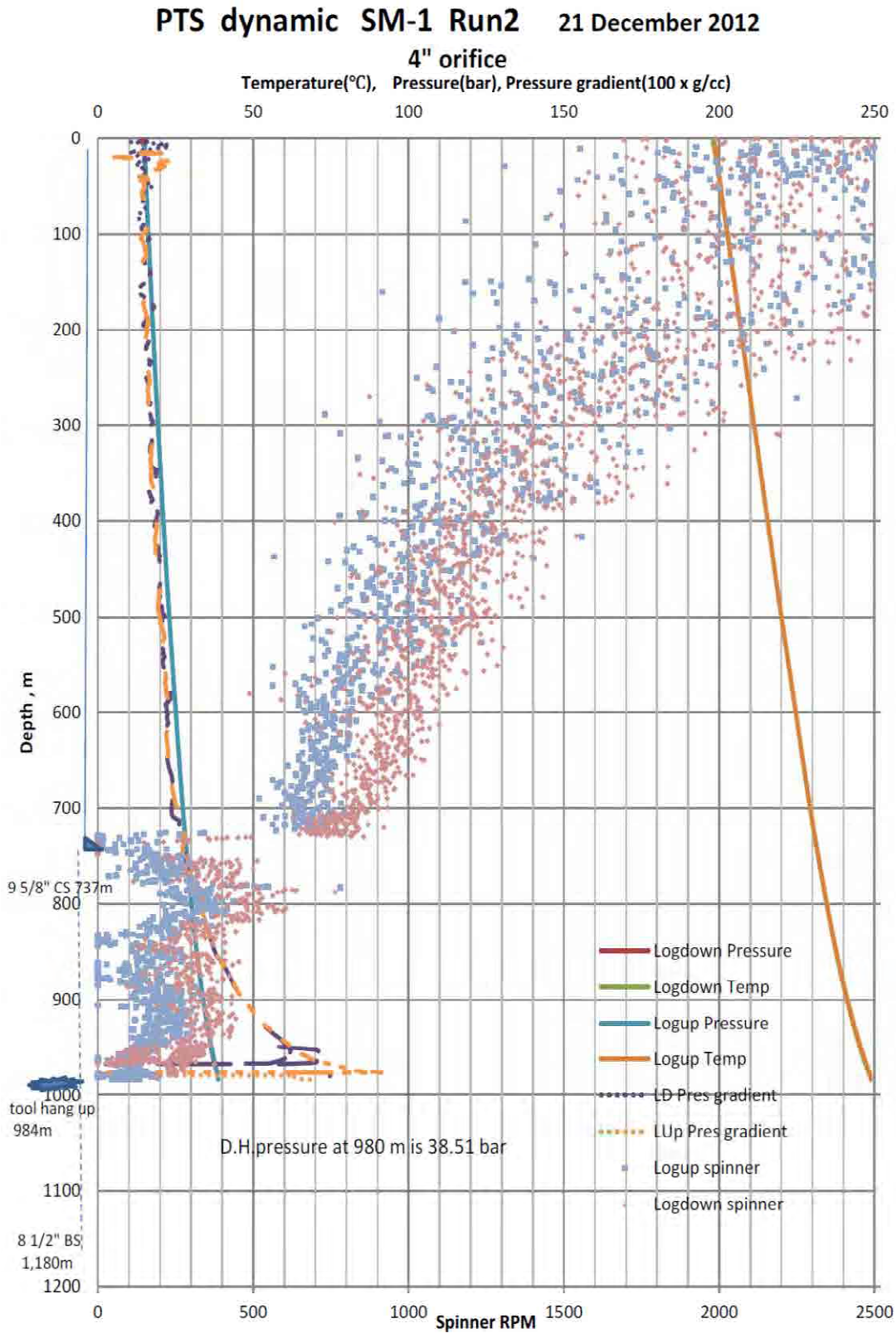
### PTS dynamic SM-1 Run1 17 December 2012



出典：JICA（2013）

図 AP2-25 SM-1 噴氣中（2”オリフィス）PTS 検層結果（2012年12月17日実施）





出典：JICA（2013）

図 AP2-26 SM-1 噴気中（4"オリフィス）PTS 検層結果（2012年12月21日実施）

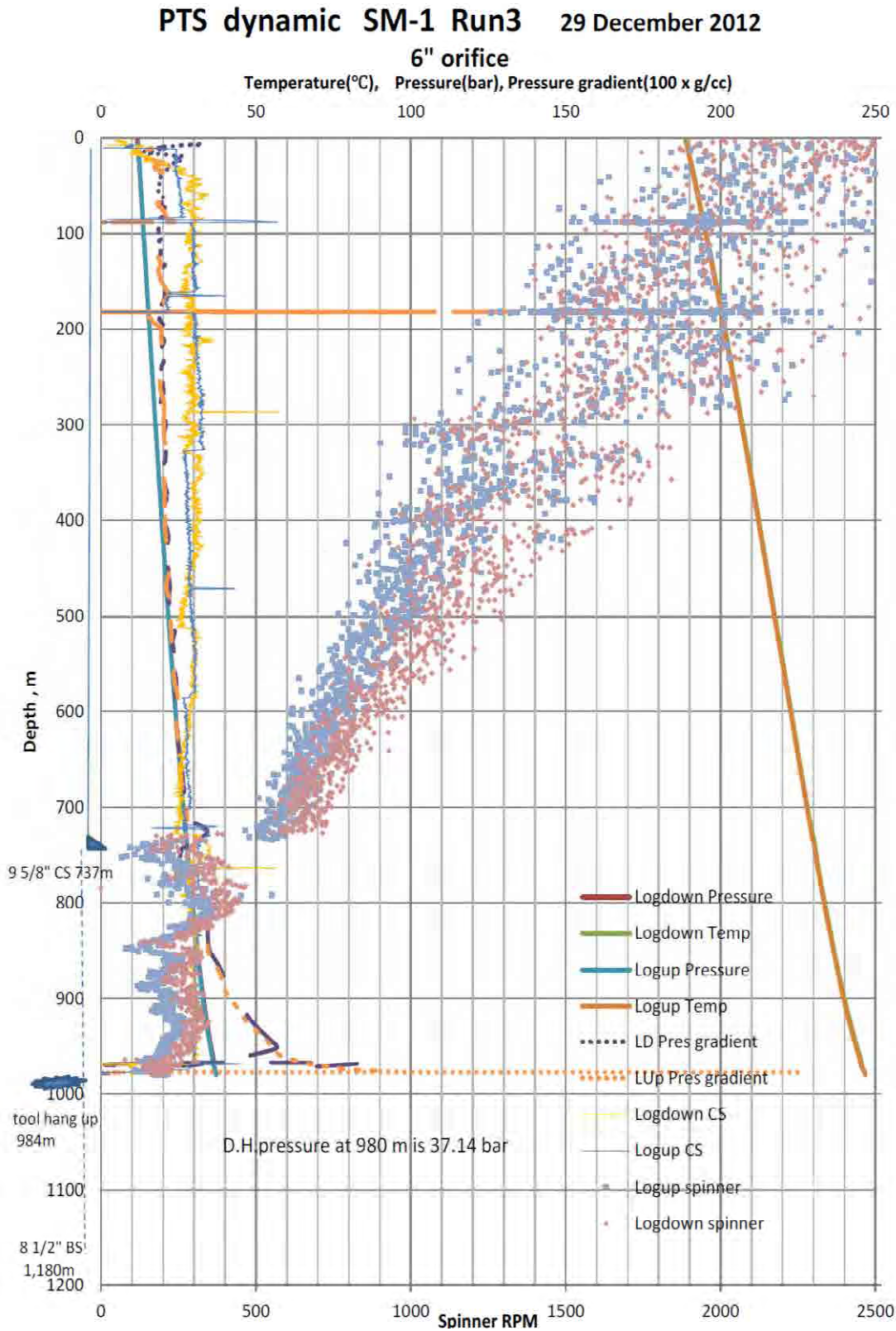


図 AP2-27 SM-1 噴気中 (6"オリフィス) PTS 検層結果 (2012年12月29日実施)

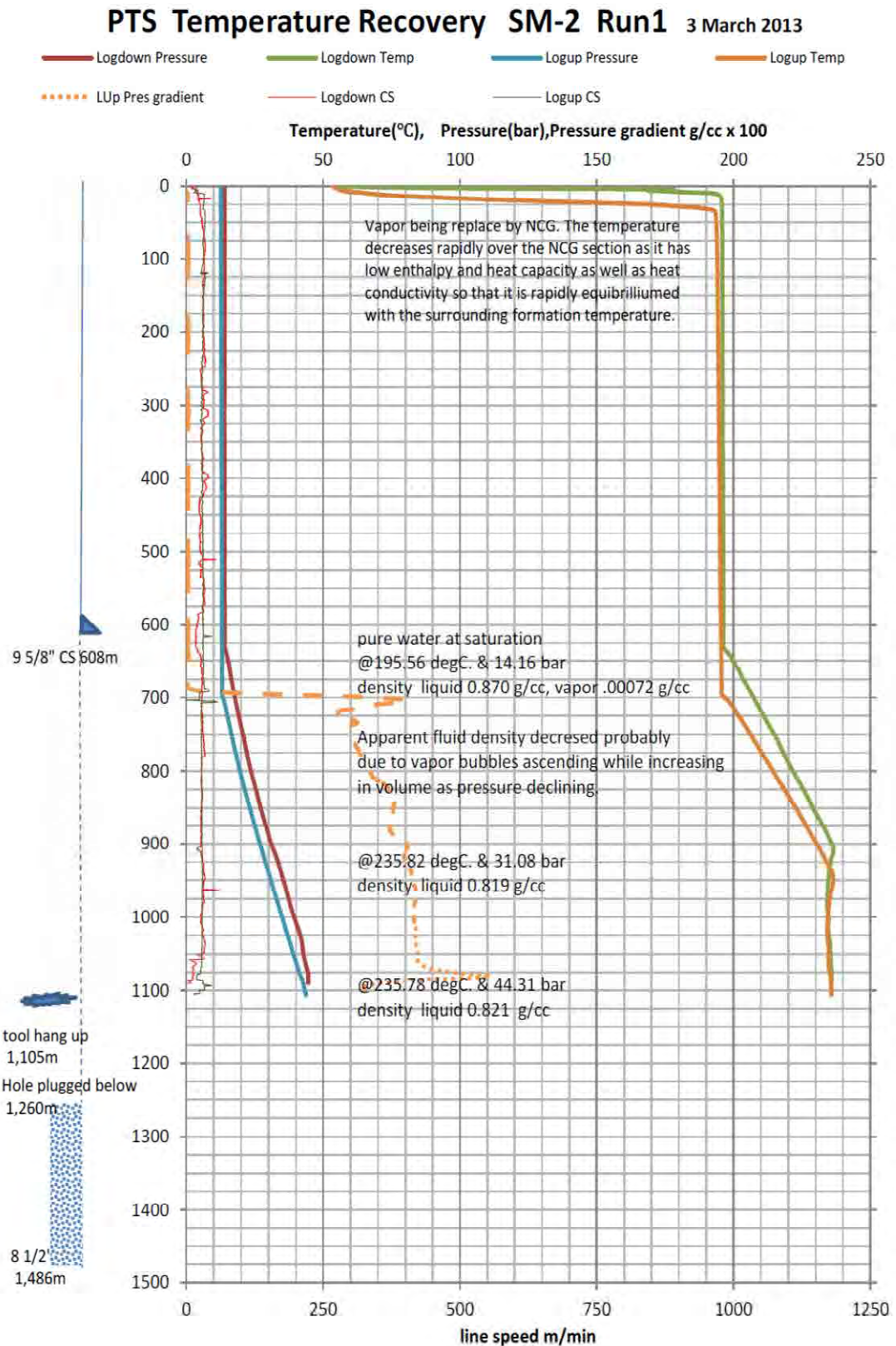
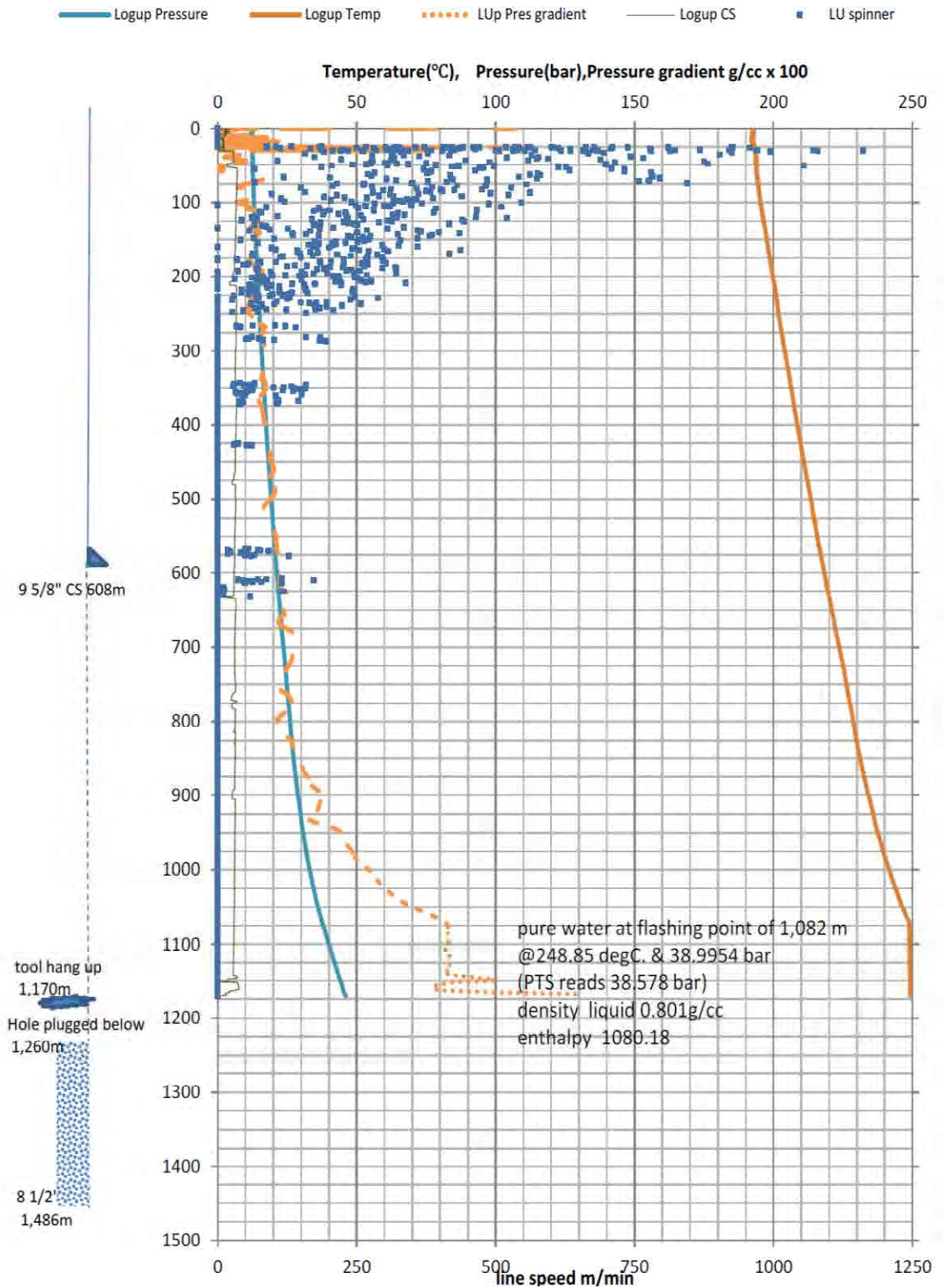


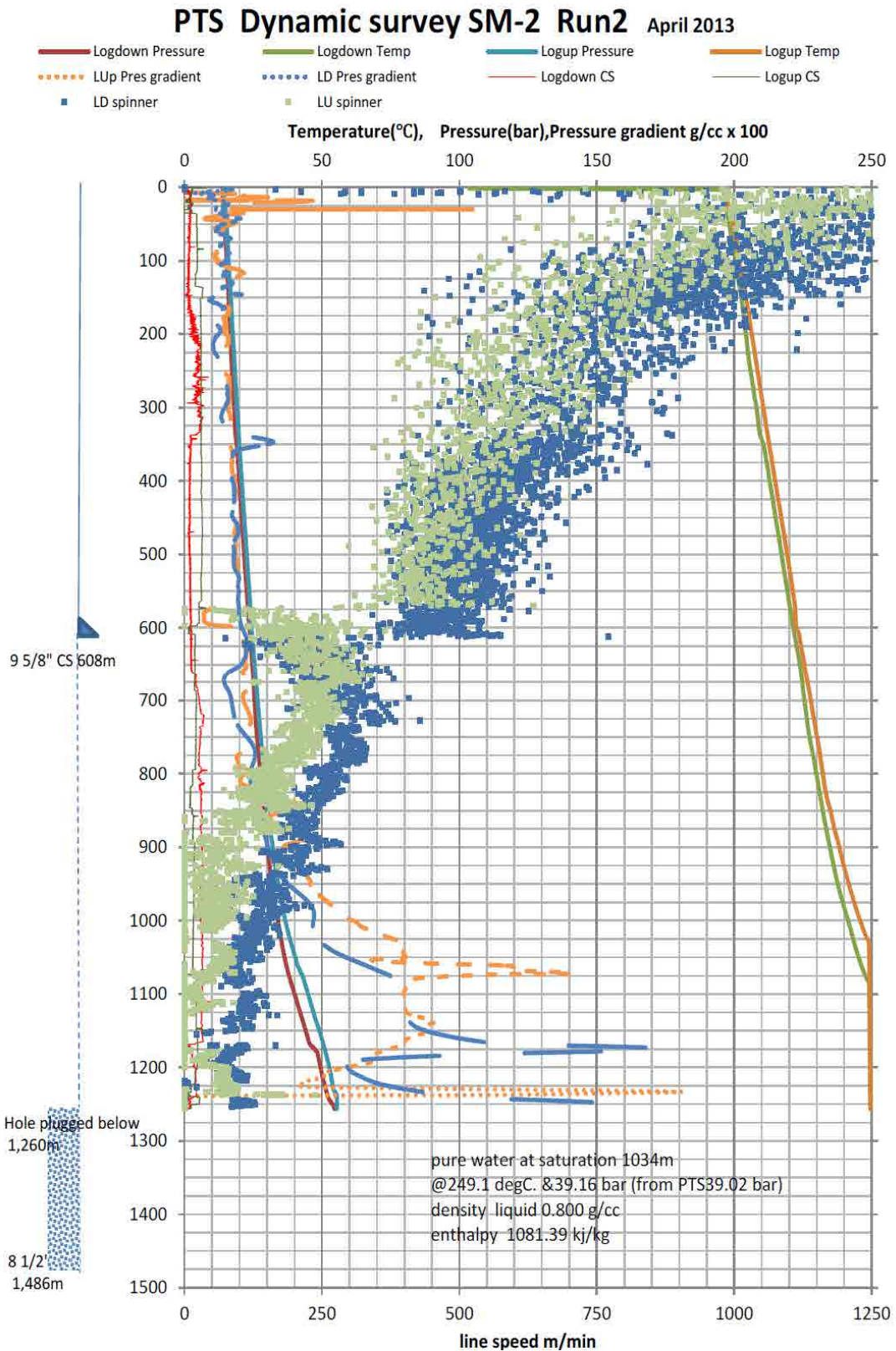
図 AP-28 SM-2 静止中（注水停止後）PT 検層結果（2013年3月3日実施）

### PTS Dynamic Survey SM-2 Run1 April 12, 2013



出典：JICA (2013)

図 AP2-29 SM-2 噴氣中 (2"オリフィス) PT 検層結果 (2013年4月12日実施)



出典：JICA (2013)

図 AP2-30 SM-2 噴氣中 (4"オリフィス) PTS 検層結果 (2013年4月実施)

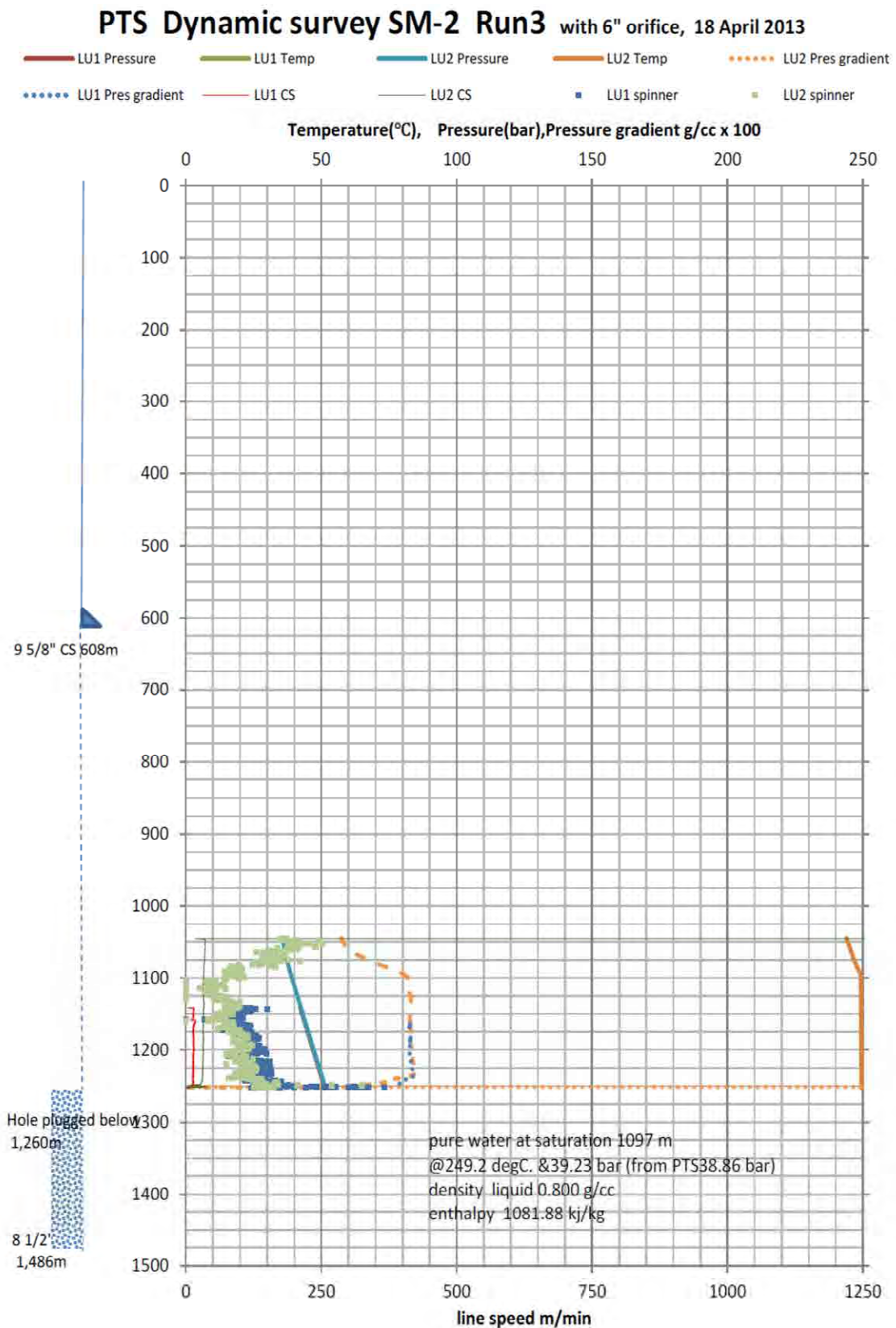
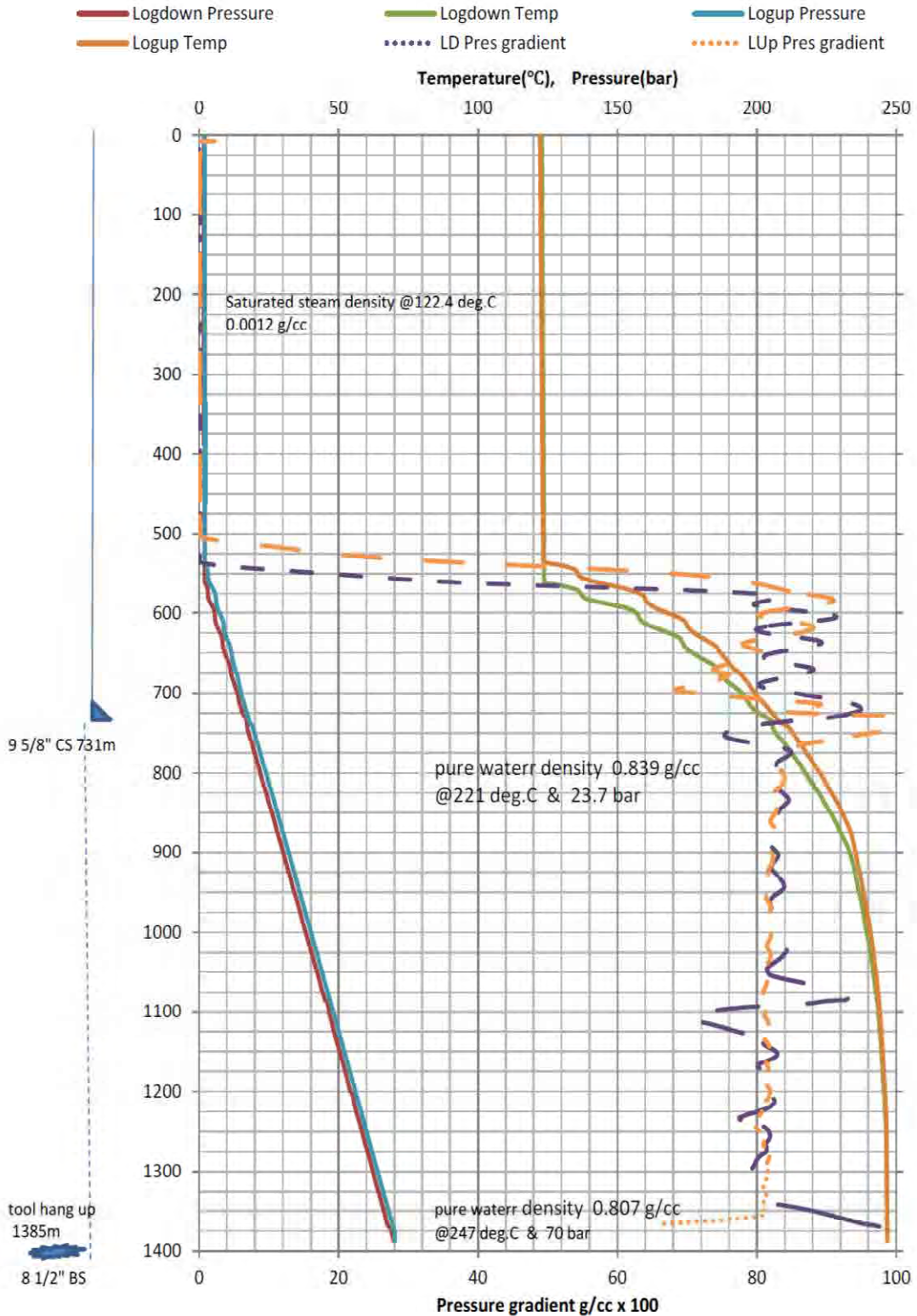


図 AP2-31 SM-2 噴気中（6”オリフィス）PTS 検層結果（2013年4月18日実施）

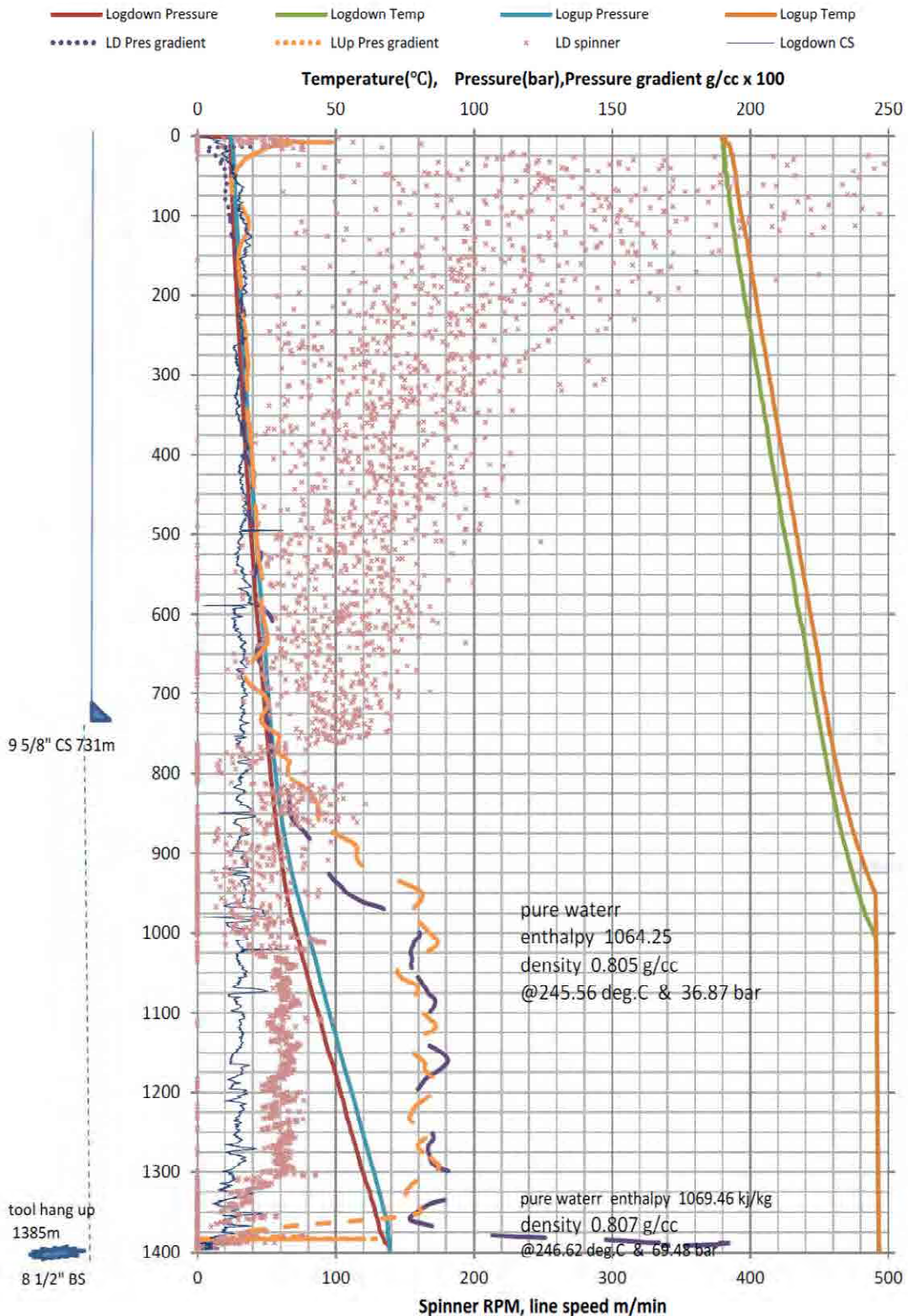
PT Static SM-3 Run1 03 December 2012



出典：JICA (2013)

図 AP2-32 SM-3 静止中 PT 検層結果 (2013 年 4 月 18 日実施)

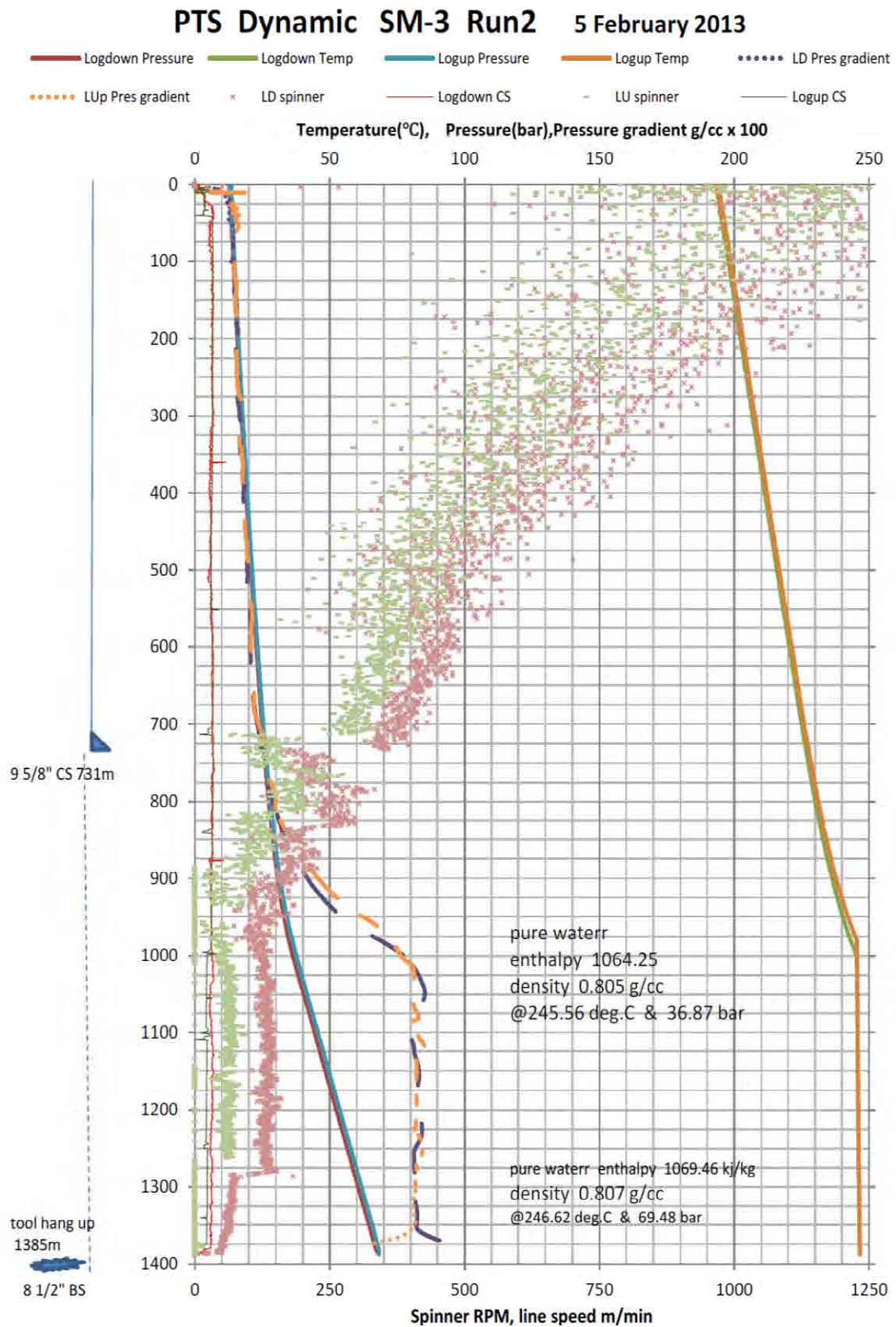
### PTS Dynamic SM-3 Run1 28 January 2013



出典：JICA (2013)

図 AP2-33 SM-3 噴気中 (2"オリフィス) PTS 検層結果 (2013年1月28日実施)





出典：JICA (2013)

図 AP2-34 SM-3 噴気中 (4”オリフィス) PTS 検層結果 (2013年2月5日実施)

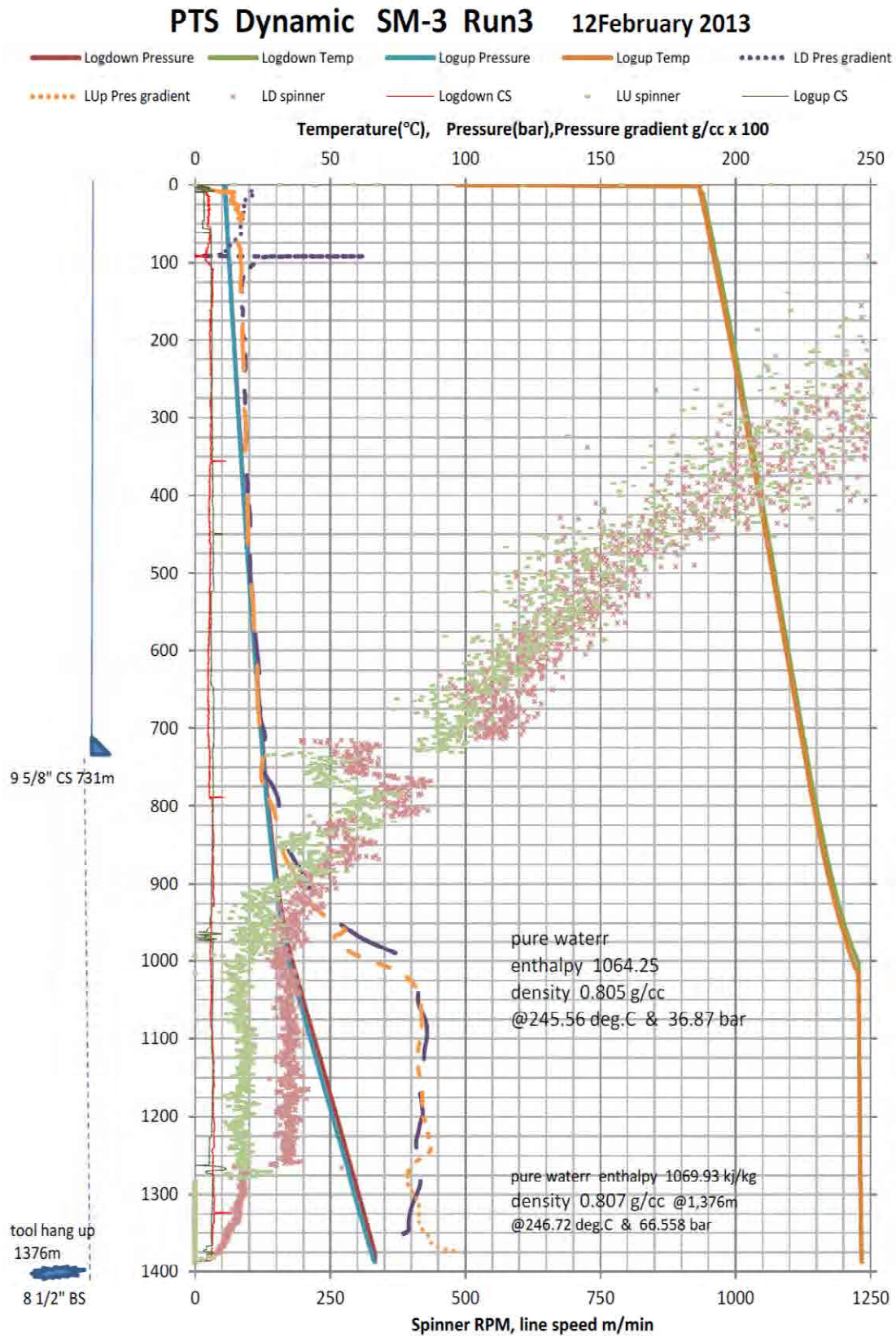


図 AP2-35 SM-3 噴気中 (6"オリフィス) PTS 検層結果 (2013年2月12日実施)

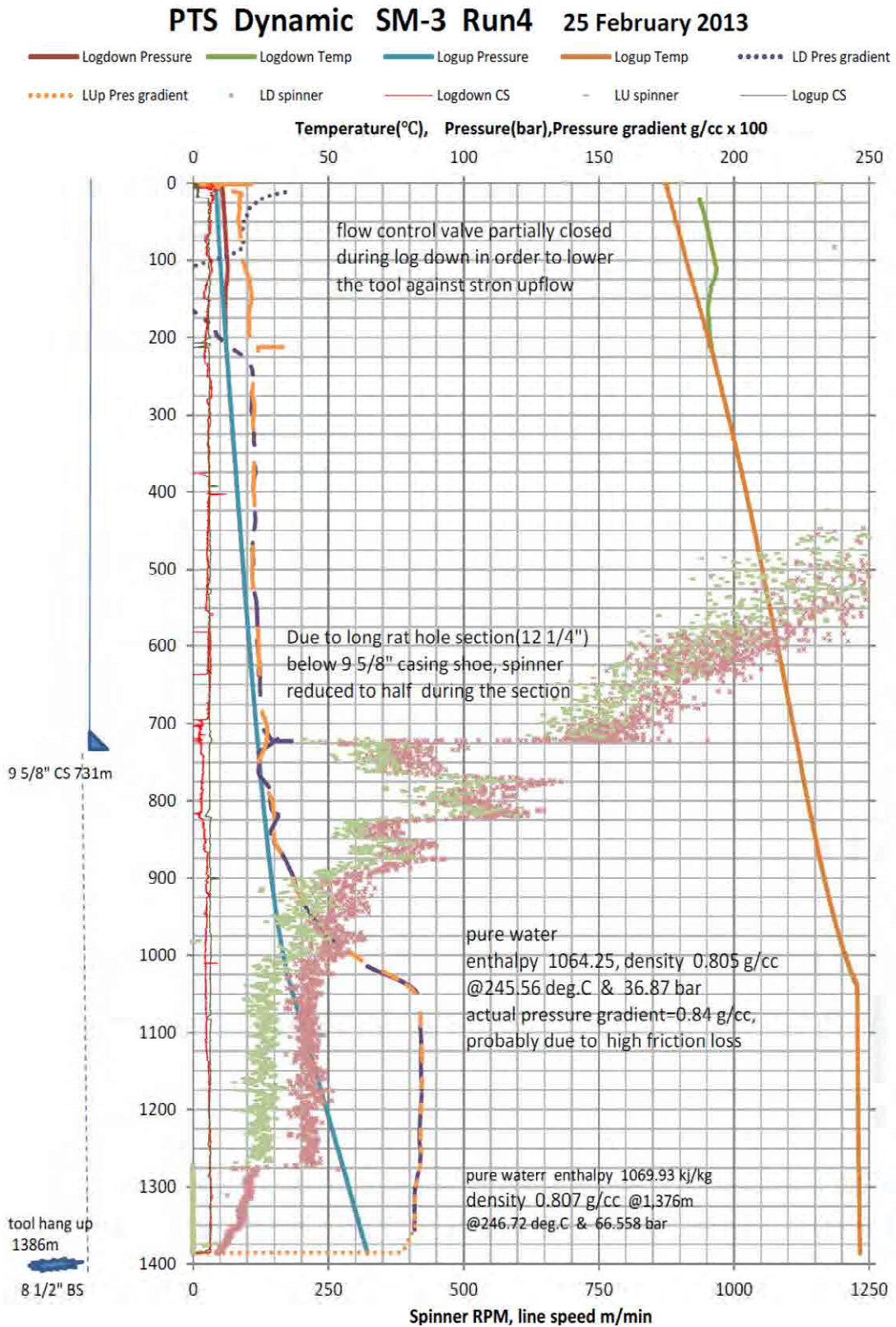
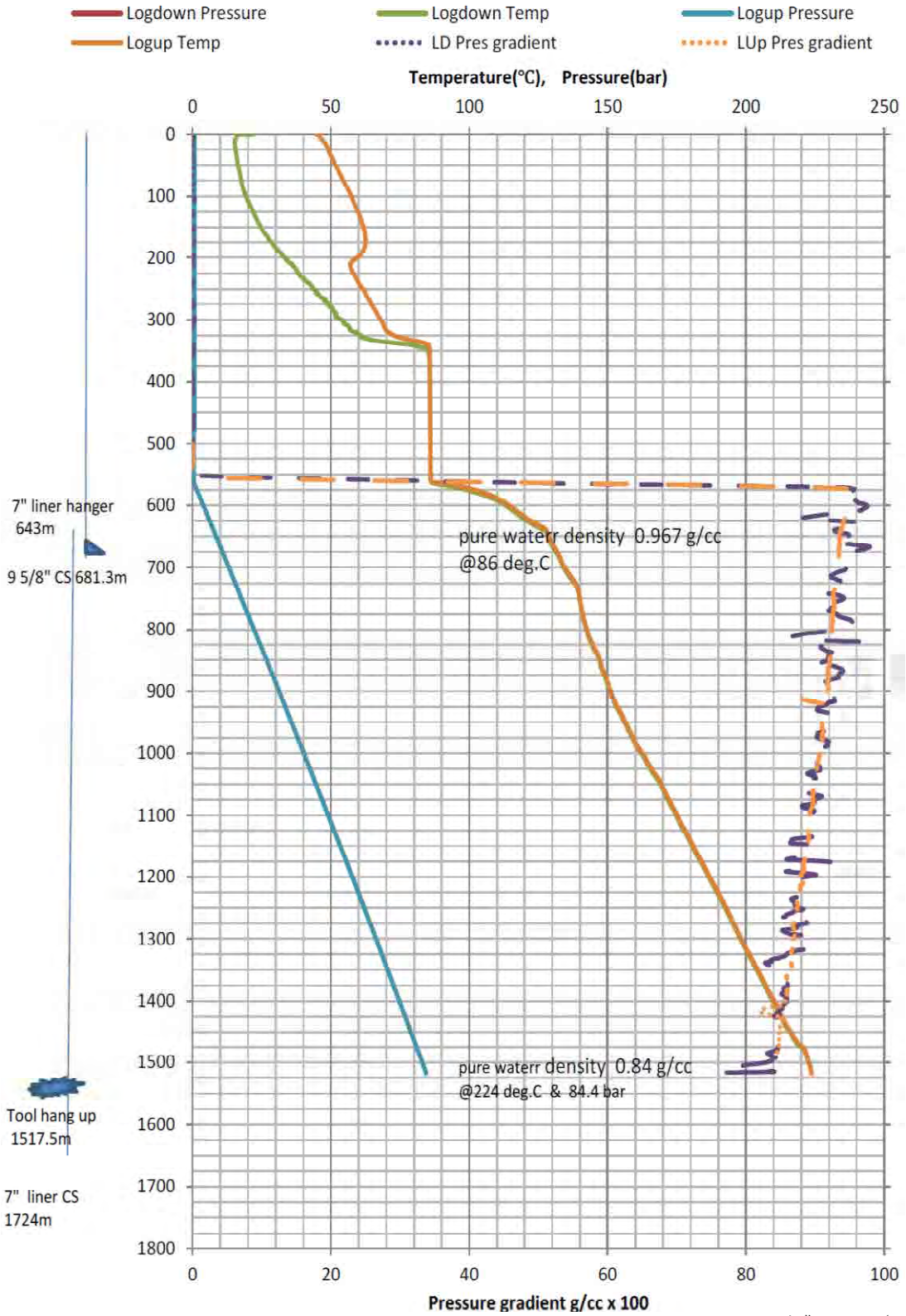


図 AP2-36 SM-3 噴気中 (8"オリフィス) PTS 検層結果 (2013年2月25日実施)

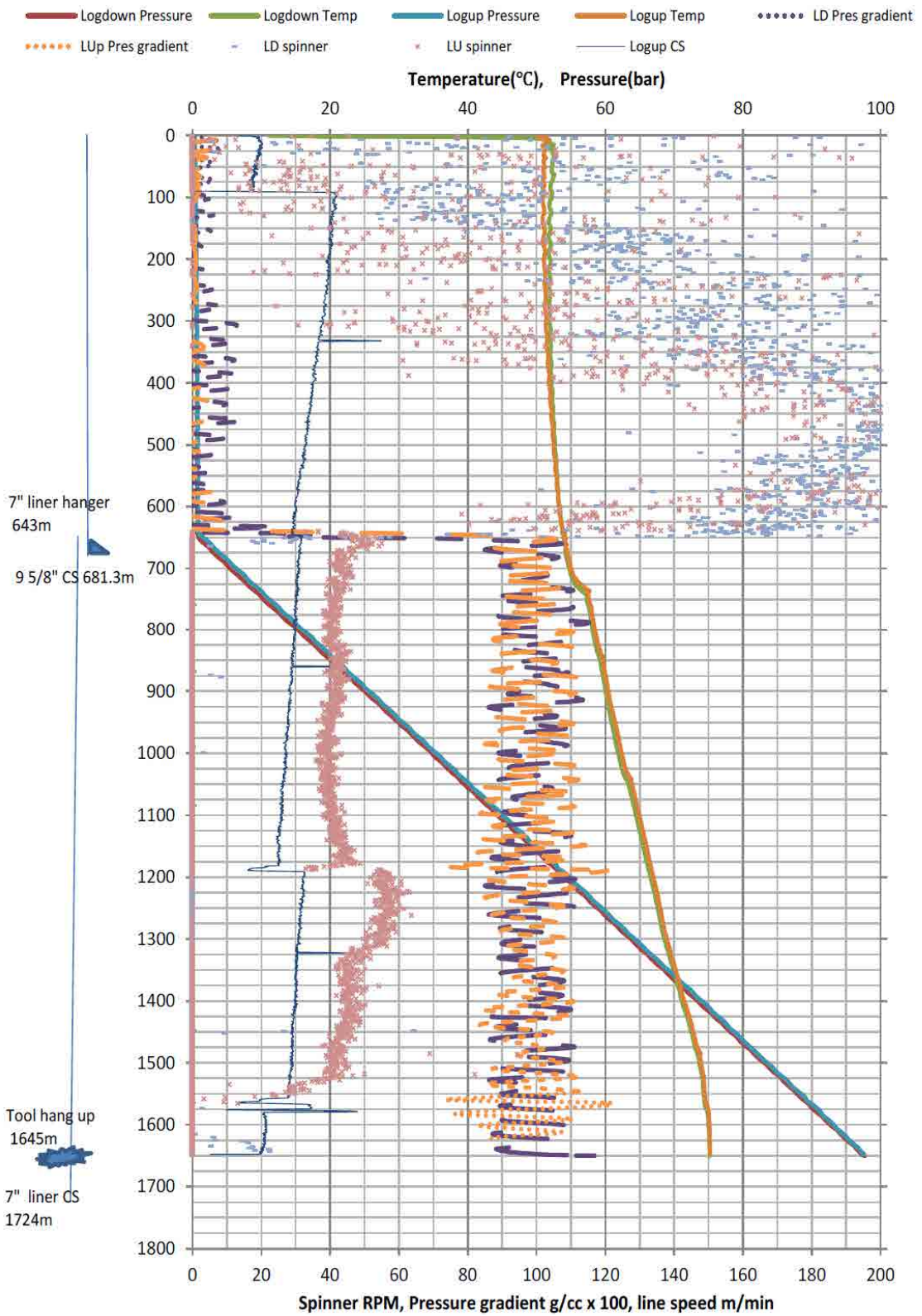
### PT Static SM-4 Run1 04 December 2012



出典：JICA (2013)

図 AP2-37 SM-4 静止中 PT 検層結果 (2012 年 12 月 4 日実施)

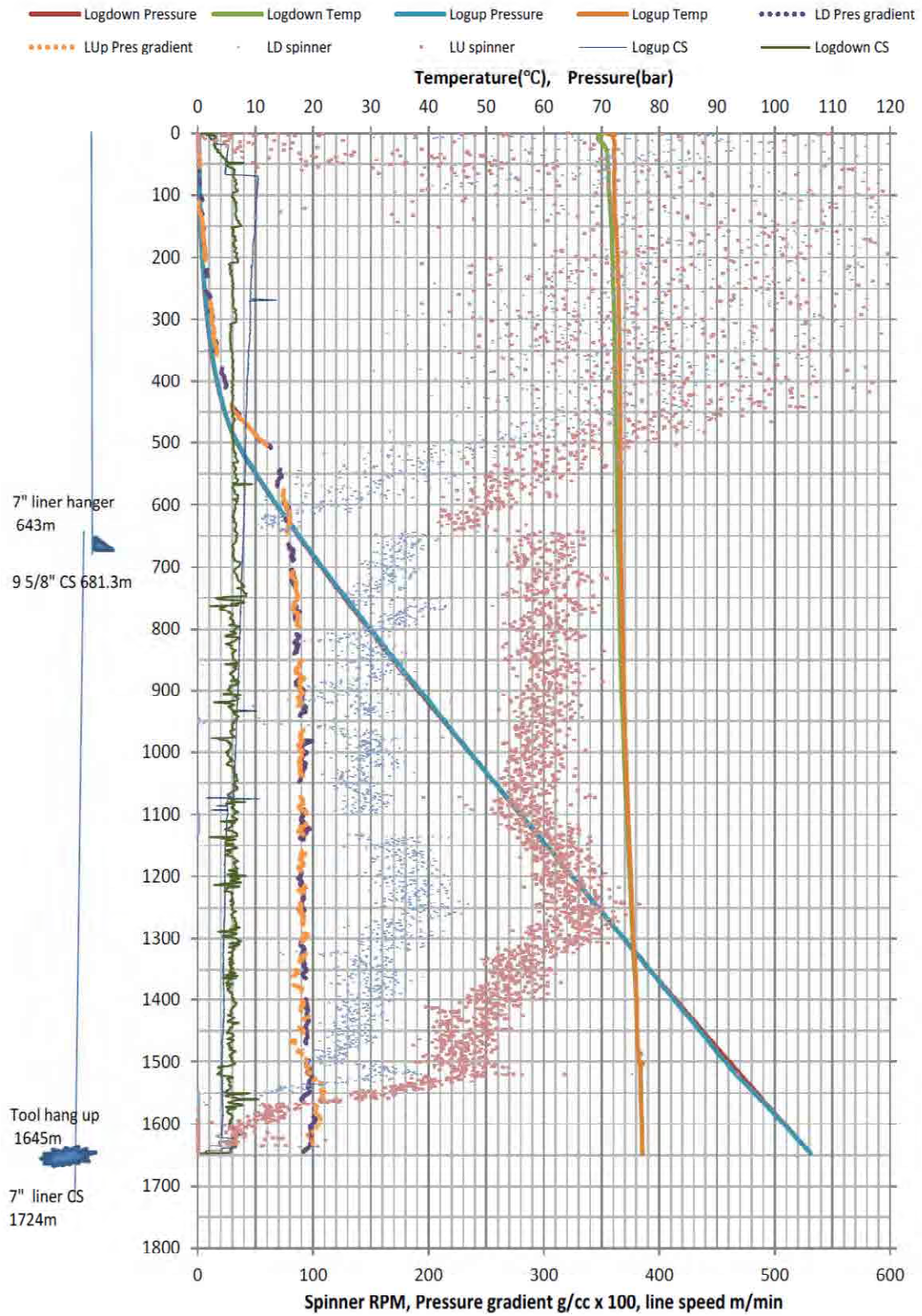
### PTS Re-injection SM-4 Run1 28 January 2013



出典：JICA (2013)

図 AP2-38 SM-4 注水中 (2”オリフィス) PTS 検層結果 (2013年1月28日実施)

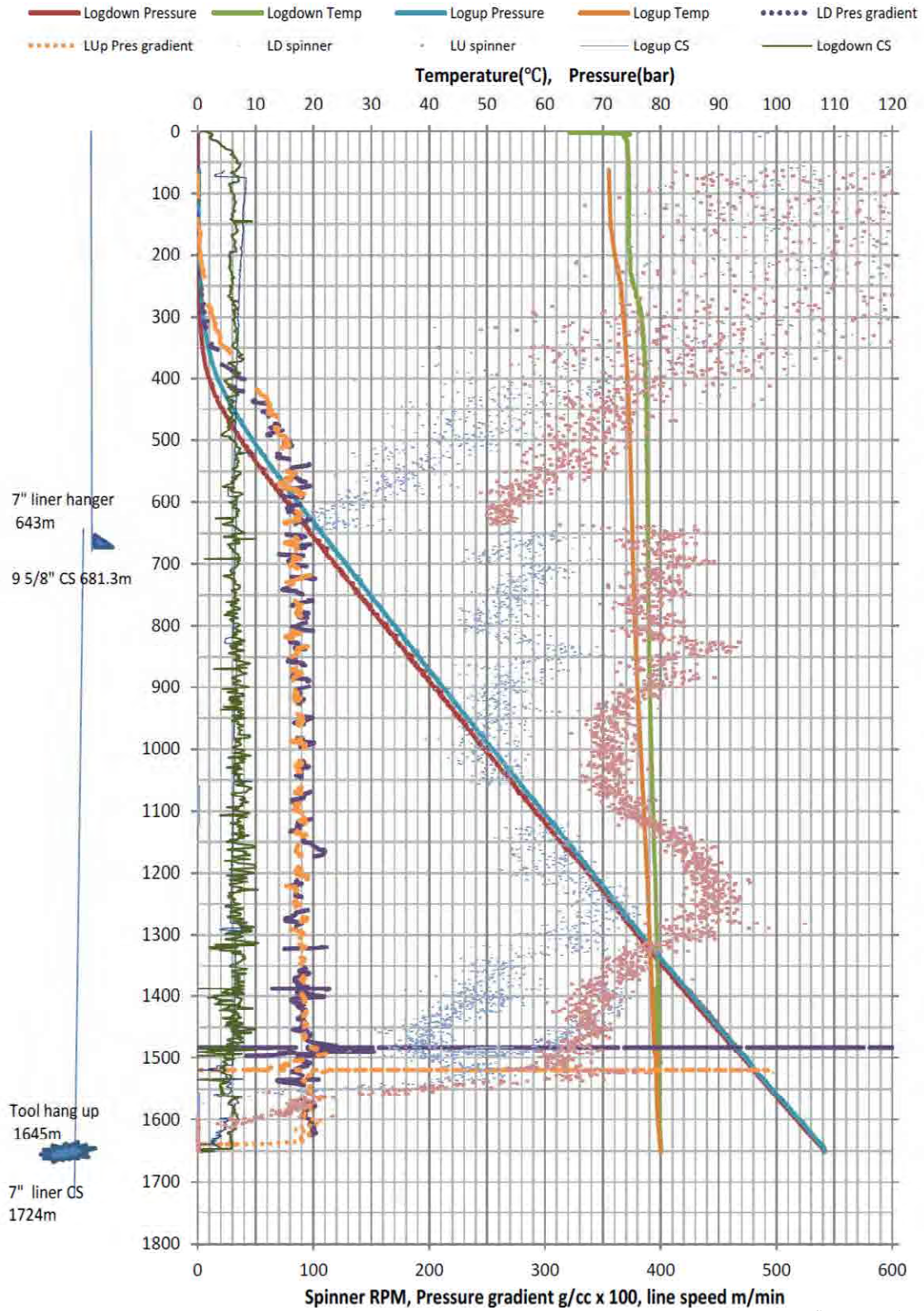
### PTS Re-injection SM-4 Run2 3 February 2013



出典：JICA (2013)

図 AP2-39 SM-4 注水中 (4”オリフィス) PTS 検層結果 (2013年2月3日実施)

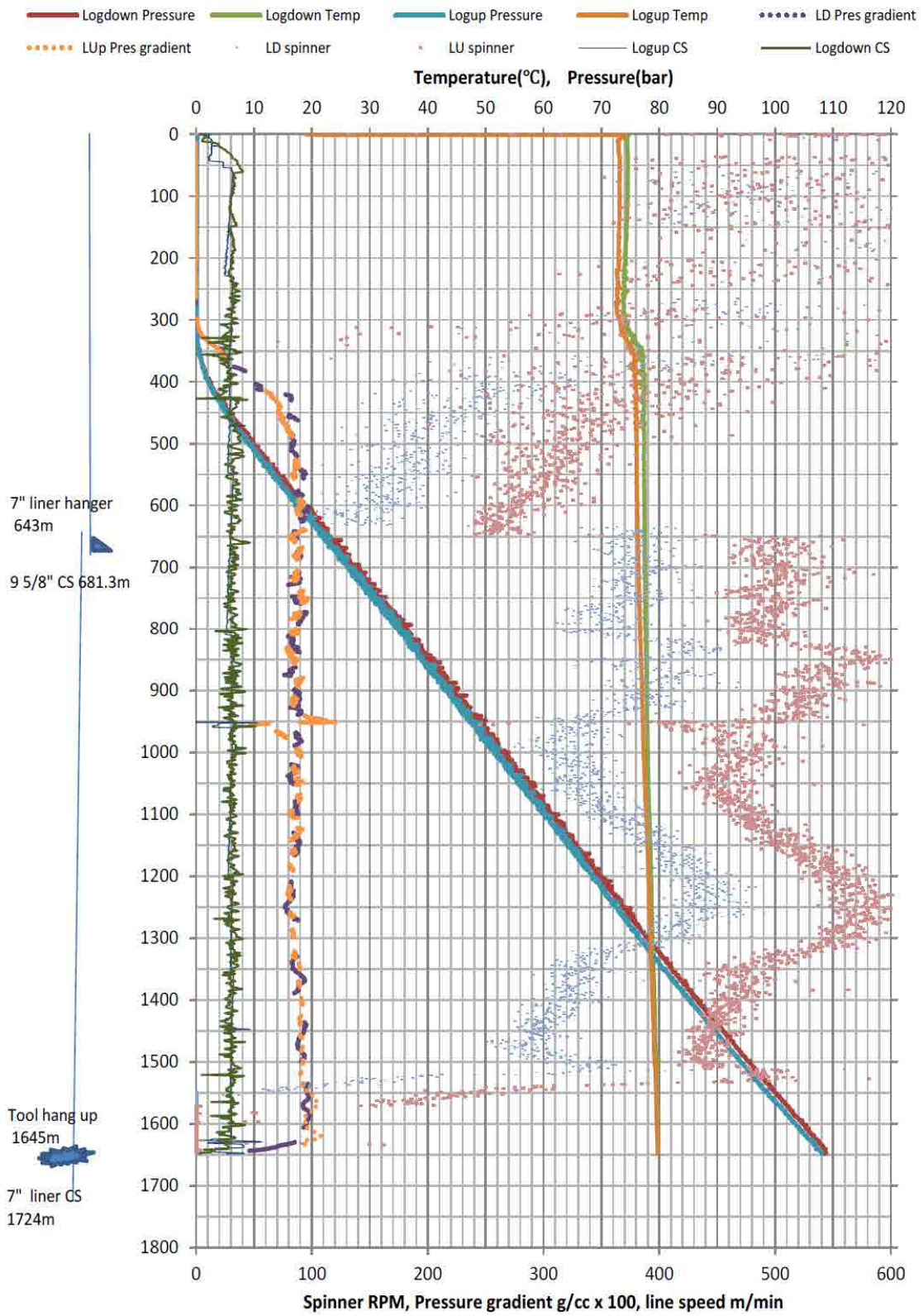
### PTS Re-injection SM-4 Run3 13 February 2013



出典：JICA (2013)

図 AP2-40 SM-4 注水中 (6”オリフィス) PTS 検層結果 (2013年2月13日実施)

### PTS Re-injection SM-4 Run4 17 February 2013



出典：JICA (2013)

図 AP2-41 SM-4 注水中 (10”オリフィス) PTS 検層結果 (2013年2月17日実施)



## Appendix-3 セミナー資料

# 第一回セミナー資料

**ASISTENCIA ESPECIAL PARA LA  
IMPLEMENTACIÓN DEL PROYECTO (SAPI)  
PARA EL PROYECTO DE CONSTRUCCIÓN DE LA  
PLANTA GEOTÉRMICA  
LAGUNA COLORADA  
(FASE 1 DE LA PRIMERA ETAPA)**

**Ist Site Study in Bolivia  
14 to 30 of March**

**March 2015**

**JICA STUDY TEAM**

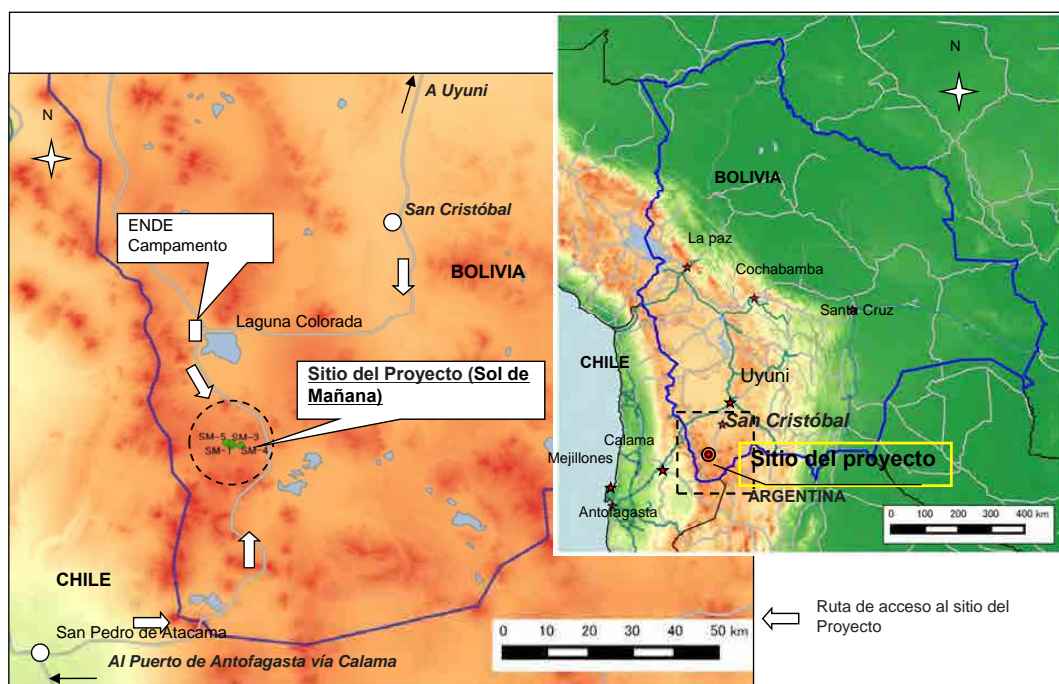
## **MEMBERS**

<b>Name</b>	<b>Position</b>
Yukinibu HAYASHI	Team Teader/ Procurement
Saúl MOLINA PADILLA	Market Trends Survey
Tsubasa AINOYAMA	Drilling Engineer
Yasushi MOMOSE	Geologist
Satoshi YOSHDA	Geochemist
Akihiko CHIBA	Geophysical Engineer
Kazuyoshi OSADA	Reservoir Engineer

# PURPOSE OF THE SAPI STUDY

- Review of the existing report and available data of Laguna Colorada Geothermal Project
- Analyzing available contract types of well drilling
- Marketing trend survey of well drilling companies in Bolivia
- Conducting seminars for ENDE staff to develop a detailed understanding of “Condition of Contract for Well Drillings” and “Technical issues of the Laguna Colorada Geothermal Field”

## STUDY AREA

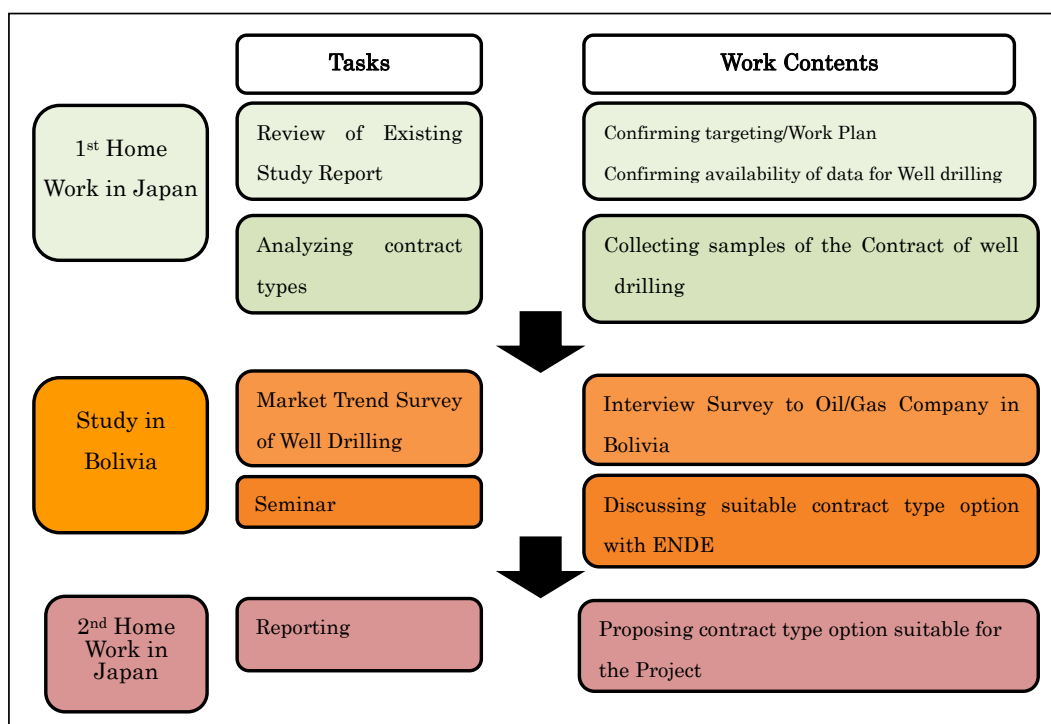


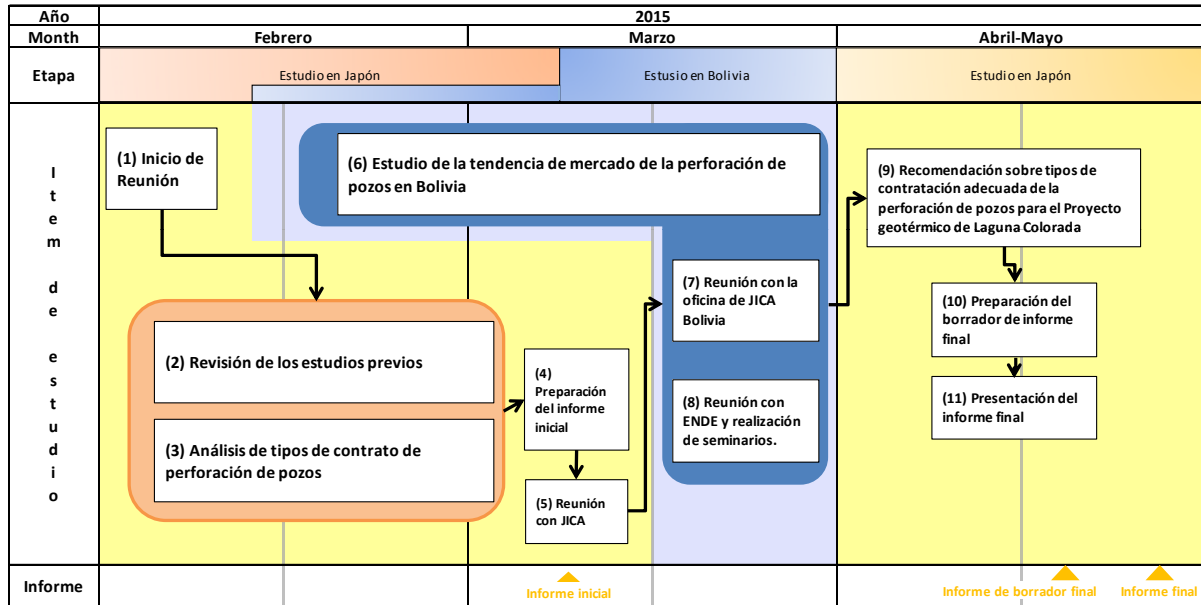
Location Map of the Project Site

# STUDY ITEMS

- Data collection of Previous Study
- Analyzing contract types
- Market trend survey of well drilling companies in Bolivia
- Seminars
- Recommendation on the appropriate types of drilling contract in the Laguna Colorada geothermal field

## WORK FLOW





## DATA COLLECTION AND REVIEW OF PREVIOUS REPORT

- **Data Collection**
- **Review of previous studies**
  - Review of geophysical survey data (gravity, MT sirvey)
  - Review of geothermal conceptual model
  - Recommendation of preparing technical specifications for drilling target
- **Wells for water supply for drilling**
  - Checking the condition and availability of existing water supply wells

## **ANALYSIS OF TYPES OF DRILLING CONTRACT**

- **Different Payment types (daily (hourly), footage , lump sum payment)**
- **Unforeseenable conditions**
- **Procurement of materials**
- **Study on variatio of drilling cost**

## **MARKET TREND SURVEY OF WELL DRILLING**

- **Interview of Oil/ Gas companies in Bolovia (Santa Cruz de la Sierra)**
- **Confirmation of the capacities of the companies**

# AGENDA OF SEMINAR (PROPOSING)

- Seminar 1 (proposing on 18 MAR)
  - Introduction of the Seminar
  - Procurement Process
  - JICA ODA Loan Standard
  - Liability of the Contract, Risks, Claim settlement etc.
- Seminar 2 (proposing on 26 MAR)
  - Market Trends of Well Drilling in Bolivia
  - Technical Review Results of Laguna Colorada Geothermal Field
  - Suitable contract types for the Laguna Colorada Geothermal Project



## SCHEDULE OF SAPI STUDY IN BOLOVIA

Fechas		Programa	Ciudad	TL/Especialista en Contratos	Estudio de Tendencia de Mercado de Empresas de Perforación	Especialista en Perforación de Pozos	Geólogo
				Nobuyuki HAYASHI NK	Saul Padilla NKLAC	Tsubasa AINOYAMA GEO-E	Yasushi MOMOSE NK
15-Mar	Dom		La Paz	Arribo a La Paz			
16-Mar	Lun		La Paz	Por la tarde: Reunión con JICA en Oficina de Bolivia			
17-Mar	Mar		Cochabamba	Por la mañana: Reunión con ENDE			
18-Mar	Mié		La Paz	Por la tarde: Seminario 1 (Normas de préstamo JICA ODA, Proceso de Contratación, etc. (Guías Generales de Contratación)), En tránsito a La Paz			
19-Mar	Jue		ENDE Camp	En tránsito al Sitio: Laguna Colorada			
20-Mar	Vie		Uyuni	Inspección del Sitio: Laguna Colorada			
21-Mar	Sáb		Uyuni	Preparación de Seminario			
22-Mar	Dom		Sta Cruz	En tránsito a Sta. Cruz,			
23-Mar	Lun		Sta Cruz	Entrevistas (Compañías de Perforación de Pozos)			
24-Mar	Mar		Sta Cruz	Entrevistas (Compañías de Perforación de Pozos)			
25-Mar	Mié		Cochabamba	Preparación de Seminario			
26-Mar	Jue		Cochabamba	Seminario 2 (resultados del estudio, Mercado de Compañías de Perforación en Bolivia, Tipo de Contrato recomendable, Aspectos Técnicos, etc.)			
27-Mar	Vie		La Paz	Reunión con JICA en Oficina de Bolivia			
28-Mar	Sáb		Uyuni	En tránsito a La Paz			
29-Mar	Dom			En tránsito a Japón/Elsalvador			
30-Mar	Lun			Arribo en Tokyo			







**Muchas Gracias**



# Laguna Colorada Geothermal Project

## Workshop 1

### Outline of IADC Drilling Contracts

March 2015

Cochabamba, Bolivia

JICA Study Team

Nippon Koei Co., Ltd.

2

### What is IADC ?

- IADC is an acronym of  
International Association for Drilling Contractors
- Since 1940, the International Association of Drilling Contractors (IADC) has exclusively represented the worldwide oil and gas drilling industry.
- Well-known in standard conditions of contracts for underground drilling works.
- Headquarters is located at Houston, Texas in the United States. Regional offices are established at Washington D.C. in United States, Nijmegen in Netherlands, Dubai in UAE and Bangkok in Thailand.

## IADC Drilling Contract Forms

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- IADC issues three kinds of model contracts which are suggested to use for the drilling works:
  - 1) Daywork Drilling Contract
  - 2) Footage Drilling Contract
  - 3) Turnkey Contract
  
- Names of contract parties are different from the FIDIC Contract Forms:
  - 1) Operator ("Employer" in FIDIC contract)
  - 2) Contractor (same as FIDIC contract)
  - 3) No "Engineer" is appointed.

## IADC Drilling Contract Principle (1)

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### ■ Daywork Drilling Contract :

The term "Daywork" or "Daywork Basis" means Contractor shall furnish the equipment, labor, and perform the services required of Contractor herein, for a specified sum per day **under the direction, supervision and control of Operator.**

Except for such obligations and liabilities specifically assumed by Contractor, **Operator shall be solely responsible and assumes liability for all consequences of operations by both parties while on a daywork basis,** including results and all other risks or liabilities incurred in or incident to such operations.

## IADC Drilling Contract Principle (2)

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### ■ Footage Contract :

The term "Footage" or "Footage Basis" means Contractor shall furnish the equipment, labor, and perform the services required to drill a well, as specified by Operator, to the Contract Footage Depth. While drilling on a Footage Basis, **Contractor shall direct, supervise and control drilling operations** and assumes certain liabilities to the extent specifically provided.

## IADC Drilling Contract Principle (3)

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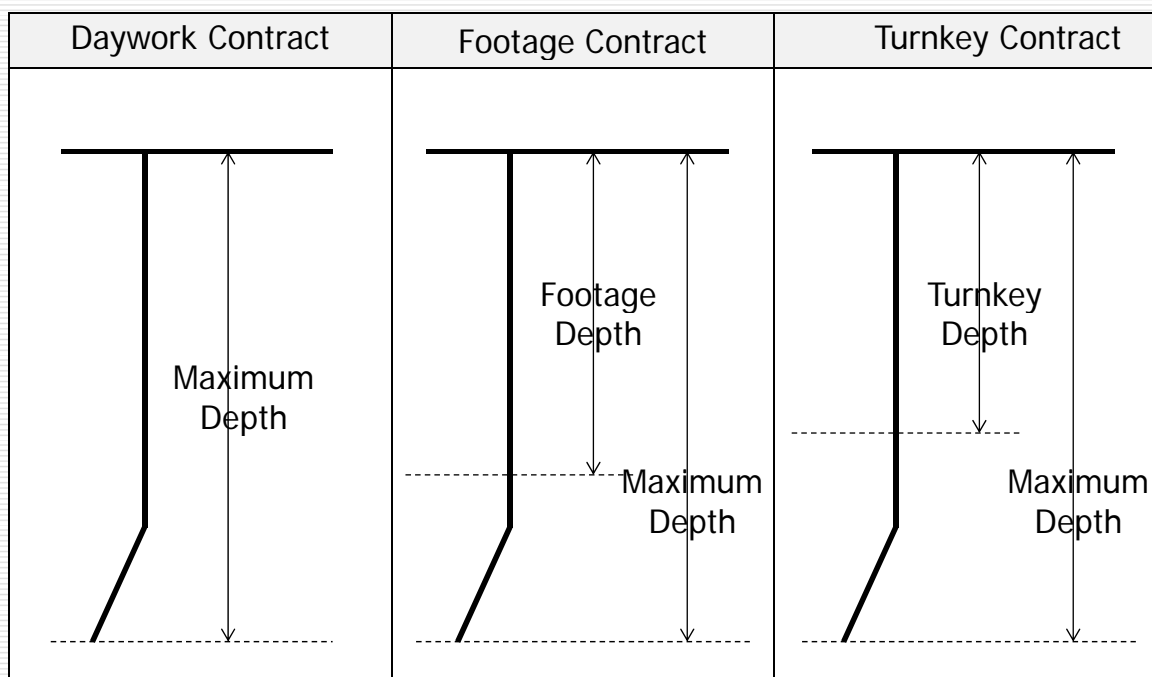
### ■ Turnkey Contract :

The term "Turnkey" or "Turnkey Basis" means Contractor shall furnish the equipment, labor, and perform the services required to drill a well, as specified by Operator, to the Turnkey Depth. While drilling on a Turnkey Basis, **Contractor shall direct, supervise and control drilling operations** and assumes certain liabilities to the extent specifically provided.

## Features of IADC Conditions of Contract

Items	Payment upon Measurements		Lump Sum Contract
	Daywork (Daily/Hourly)	Footage	Turnkey
Construction Period	Specified	Not specified	Not specified
Depth	Maximum Depth specified	Footage Depth and Maximum Depth specified	Turnkey Depth and Maximum Depth specified
Rate	<ul style="list-style-type: none"> <li>- Mobilization Fee</li> <li>- Demobilization Fee</li> <li>- Operating Rate</li> <li>- Standby Time Rate</li> <li>- Rate During Repair</li> <li>- Force Majeure Rate</li> <li>- etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Footage Rate</li> <li>- Standby Time Rate</li> <li>- Work Stoppage Rate</li> <li>- Operation Rate (optional)</li> <li>- Drilling Fluid Rate</li> <li>- Reimbursable Rate</li> <li>- etc.</li> </ul> (Operating Rate can be applied for the part that daily basis is applied.)	<ul style="list-style-type: none"> <li>- Turnkey Amount</li> <li>- Standby Time Rate</li> <li>- Work Stoppage Rate</li> <li>- Operation Rate (optional)</li> <li>- Drilling Fluid Rate</li> <li>- Reimbursable Rate</li> <li>- etc.</li> </ul> (Operating Rate can be applied for the part that daily basis is applied.)
Payment	Monthly	Upon completion of services of Footage Depth	Upon completion of services of Turnkey Depth
Unforeseeable Conditions	Standby Rate will be applied during suspension.	For Footage Depth, Operating Rate can be applied, if progress becomes very slow.	For Turnkey Depth, no price adjustment is allowed.

## Maximum Depth, Footage Depth and Turnkey Depth



## Comparison between FIDIC Pink and IADC Daily Basis

Item	FIDIC Pink Book	IADC Daily Basis
Responsibility of Access Road Maintenance	Contractor	Operator
Submission of Performance Security by the Contractor	Required	Not Required
Retention Money	Specified	Not Specified
Delay Damage	Specified	Not Specified
Defect Notification Periods (Guarantee Period)	Specified	Not Specified
Process of Taking-Over	Specified	Not Specified
Entitlement of the Contract Termination	Both the Employer and the Contractor are entitled to do.	Only the Contractor is entitled to do.
Claim Resolution Procedure	Specified in detail	Not Specified.
Dispute Resolution	- Dispute Board - Arbitration	Refer to the court of jurisdiction.

## Laguna Colorada Geothermal Project

### Workshop 1

## Outline of IADC Drilling Contracts

March 2015

Cochabamba, Bolivia

JICA Study Team

Nippon Koei Co., Ltd.

# Laguna Colorada Geothermal Project

## Workshop 1

### Procurement under JICA ODA Projects

March 2015

Cochabamba, Bolivia

JICA Study Team

Nippon Koei Co., Ltd.

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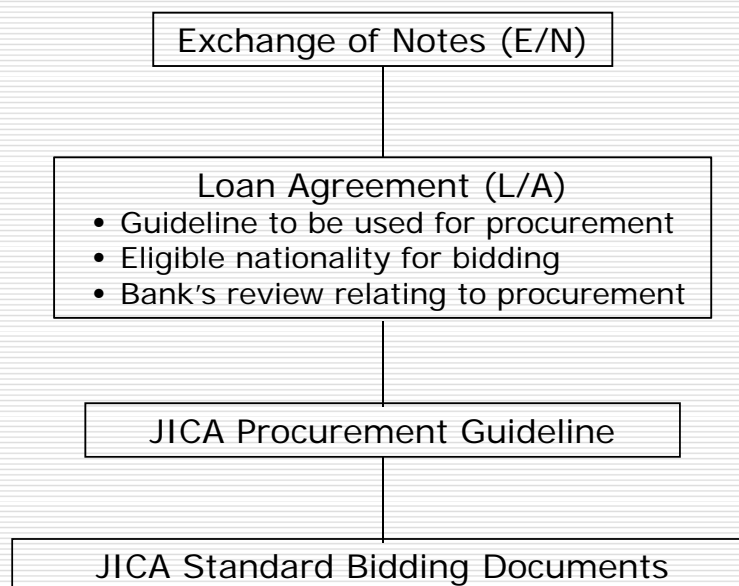
### Presentation Topics

1. Procurement Principle under JICA ODA loans
2. Procurement Process
3. FIDIC Contracts and JICA Standard Bidding Documents
4. Employer's Obligations under FIDIC Pink Book
5. Contractor's Obligation under FIDIC Pink Book
6. Engineer's Roles and Obligations under FIDIC Pink Book
7. Claim and Dispute Resolution
8. Important Aspects of Contract
9. Discussions

# 1. Procurement Principle under JICA ODA loans

4

## Documents related to Procurement





# JICA Procurement Guideline

## C. Bidding Documents

### Section 4.01 General

- (2) Borrowers shall use the appropriate Standard Bidding Documents (SBDs) of the latest version issued by JICA with minimum changes acceptable to JICA, as necessary to address project-specific conditions. Any such changes shall be introduced only through bid data sheets, or through special conditions of contract, and not by introducing changes in the standard wording of JICA's SBDs. When no relevant SBDs have been issued, the Borrower shall use other internationally recognized standard conditions of contract and contract forms acceptable to JICA.

## JICA Standard Bidding Documents

No.	Standard Bidding Documents	Applicable to LC Project	
		Drilling Works	Drilling Materials
1.	Prequalification Documents	○	△
2.	Procurement of Works	○	
3.	Procurement of Plant Design, Supply and Installation		
4.	Procurement of Small Works		
5.	Procurement of Goods		○

### Notes:

- 1) All the documents are available at:

[http://www.jica.go.jp/english/our\\_work/types\\_of\\_assistance/oda\\_loans/oda\\_op\\_info/guide/index.html](http://www.jica.go.jp/english/our_work/types_of_assistance/oda_loans/oda_op_info/guide/index.html)

- 2) JICA will release new standard bidding documents for Design Build work using FIDIC Yellow Book soon.

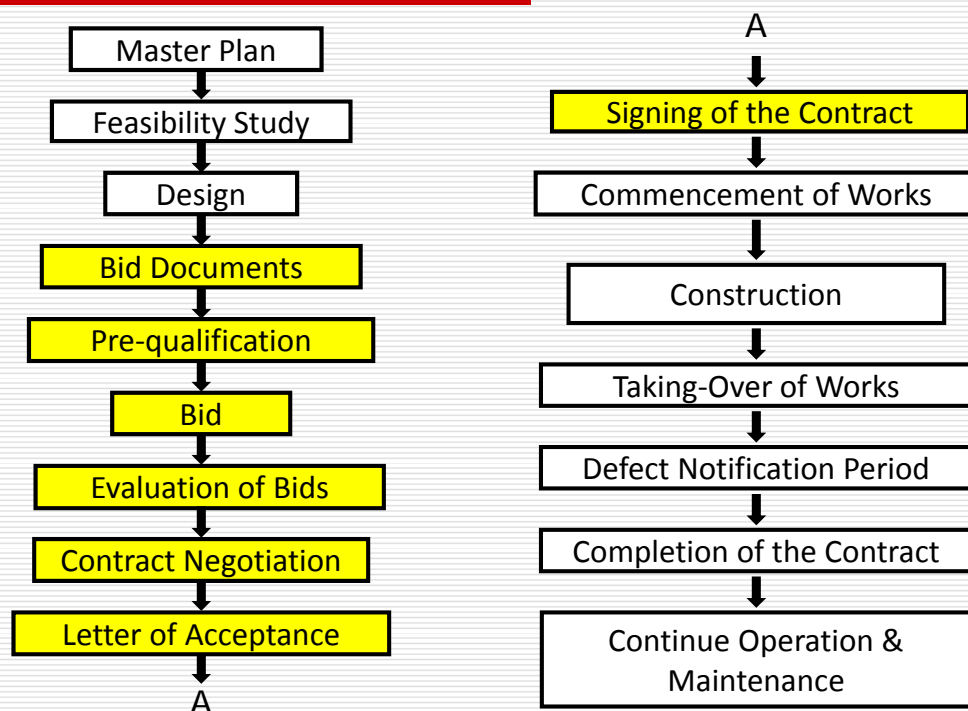
## 2. Procurement Process

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### Project Milestones

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## Prequalification of Bidders

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### B. Advertising and Prequalification

#### Section 3.02 Prequalification of Bidders

- (1) Prequalification is in principle required in advance of bidding for large or complex works and, exceptionally, for custom-designed equipment and specialized services to ensure that invitations to bid are extended only to those who are technically and financially capable.

## Procurement : Principle

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- The purpose of procurement is to select the best suited contractors for the project.
- The procurement management is one of the most important project management areas.
- The procurement process is critical for success of the project.
- Don't select the contractor only on price alone. It is very important to verify contractor's financial, technical and management capabilities in the bidding process.

## Procurement : Procedure

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### 1. Pre-qualification (to verify firm's general capability)

- To confirm eligibility of applicants
- To check financial capacity of applicants
- To check track records (work experience) of applicants

### 2. Tender Evaluation (to verify firm's readiness to complete the Works)

#### 1) General Evaluation (pass or fail)

- To check tender security/bond
- To check formality of tender
- To check completeness of tender documents
- To check major deviation

## Procurement : Procedure

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### 2) Technical Evaluation (pass or fail with scoring)

- To check team organization
- To check capability of key staff
- To check management plan (quality, safety, environment)
- To check work programme
- To check construction method
- To check construction equipment and plant

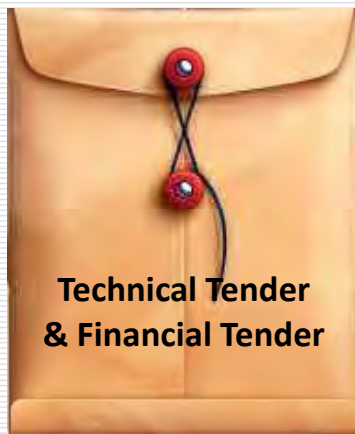
### 3) Price Evaluation (ranking)

- To check arithmetical error
- To rank the bidders
- To determine the lowest evaluated bidder

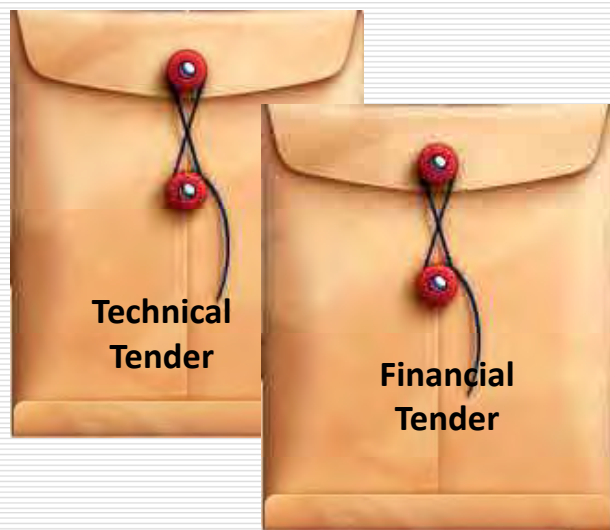
## Procurement : One-Envelope or Two-Envelope

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### One Envelope



### Two Envelope



## *3. FIDIC Contracts and JICA Standard Bidding Documents*

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## Typical Structure of Contract Documents

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- (1) Contract Agreement
- (2) Letter of Acceptance
- (3) Letter of Bid
- (4) Particular Conditions of Contract
- (5) **General Conditions of Contract (FIDIC contracts, etc.)**
- (6) Specifications
- (7) Drawings
- (8) Schedules and any other documents forming part of the Contract

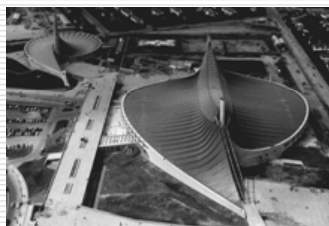
## What is FIDIC ?

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- FIDIC is an acronym of  
Federation Internationale des Ingenieurs-Conceils  
(English: International Federation of Consulting Engineers)
- Founded in 1913 in Belgium to improve business climate and promote the interests of consulting engineering firms, consistent with the responsibility to provide quality services for the benefit of society and the environment.
- Has more than 1.5 million CE professionals and 99 Member Associations worldwide.
- Run mostly by volunteers.
- Well-known in standard conditions of contracts for infrastructure development projects.

## FIDIC Centenary Awards in 2013

- FIDIC delivered Centenary Awards at FIDIC annual conference in Barcelona in September 2013. Awards were given to projects and individuals having made a significant contribution over the last 100 years.
- Japan nominated 2 projects and 1 individual and all of them were awarded.



Yoyogi Olympic Stadium  
(Building Works)



Tokaido Bullet Train  
(Civil Works)







Mr. Yutaka Kubota  
(Engineer)

## FIDIC Centenary Awards in 2013







President Hirose of Nippon Koei received Trophy in recognition of Mr. Kubota's lifetime achievements

## FIDIC Contracts (1)

Color	Title	Edition	Year	Design	Engineer
Red 	CC for Construction (CC: Conditions of Contract)	1	1999	Empl.	Yes
Pink 	MDB Harmonized Edition CC for Construction	1 2 3	2005 2006 2010	Empl.	Yes
Yellow 	CC for Plant and Design Build	1	1999	Contr.	Yes
Silver 	CC for EPC/Turnkey Projects	1	1999	Contr.	No

## FIDIC Contracts (2)

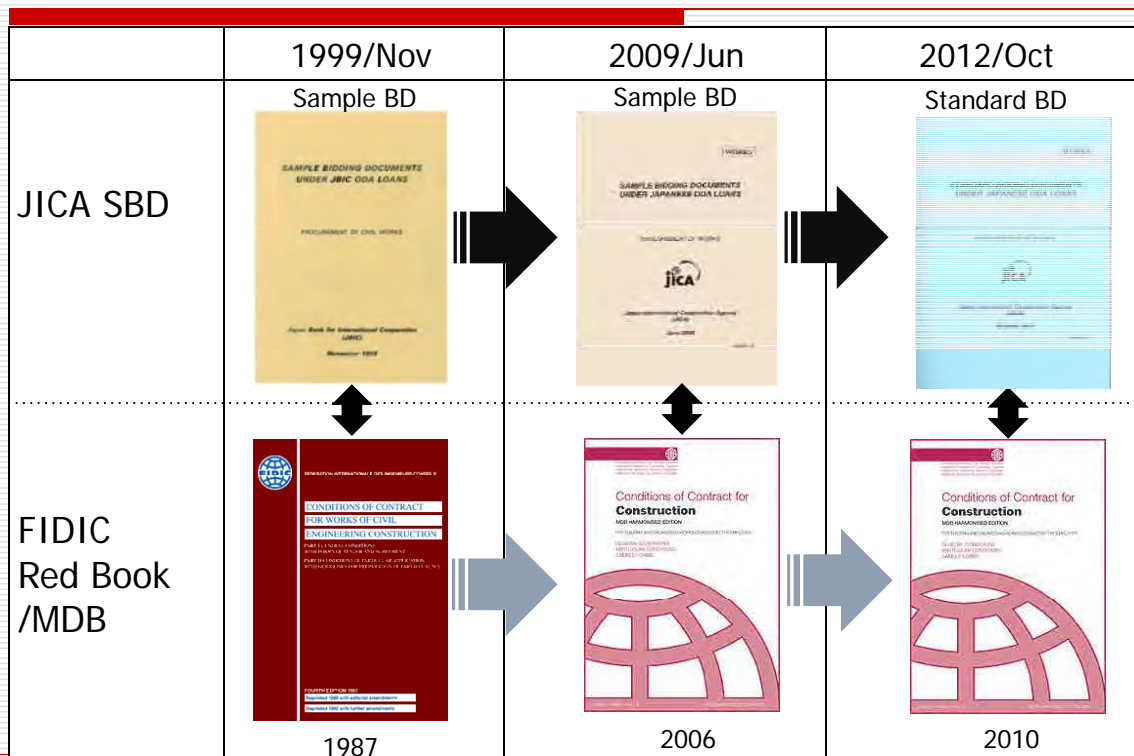
Color	Title	Edition	Year	Design	Engineer
Green 	Short Form of Contract	1	1999	Empl. or Contr.	No
Blue 	CC for Dredging and Reclamation Work	1	2006	Empl. or Contr.	Yes
Gold 	CC for Design, Build and Operate Projects	1	2008	Contr.	No
White 	Client/Consultant Model Services Agreement	4	2006	-	-



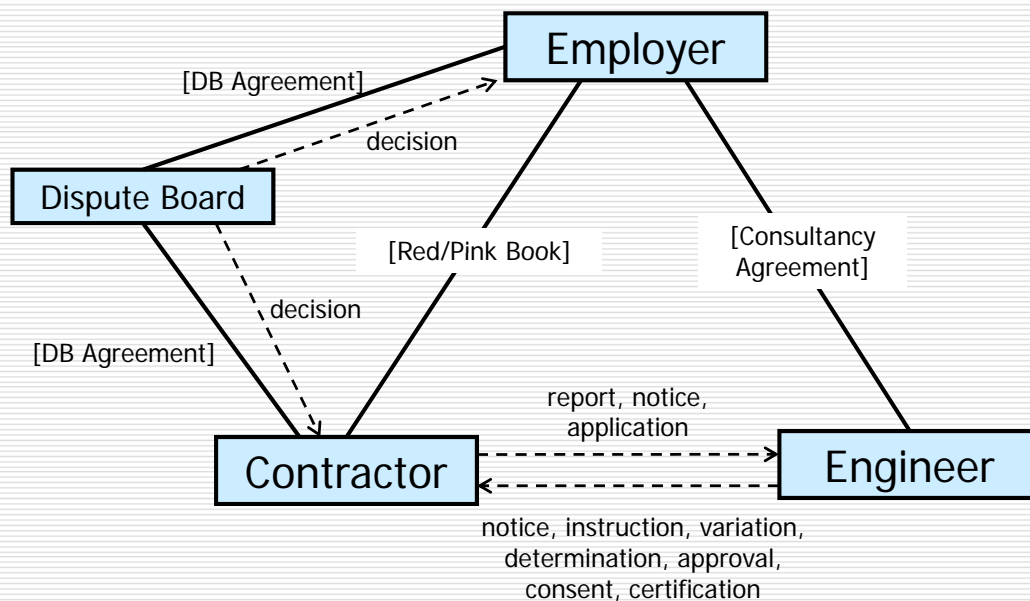
## FIDIC MDB Harmonized Edition (Pink Book)

- FIDIC MDB edition (Pink Book) is used as Conditions of Contract for Construction for long time by :
  - 1) MDBs (Multilateral Development Banks)
    - World Bank
    - IDB (Inter-American Development Bank)
    - Asian Development Bank
    - African Development Bank , etc.
  - 2) JICA
- This means FIDIC Pink Book has been used in a lot of projects worldwide.

## FIDIC Contract used in JICA Standard Bidding Documents



## Organization under FIDIC Red/Pink Book



## Risk Allocation between Parties (Pink Book)

- When either contract party (Employer or Contractor) fails to fulfill his obligation under the Contract and other party suffers loss or damage, the failing party shall compensate such loss or damage. In addition, if the Contractor suffers loss or damage due to neutral event (which is not controllable by both parties), the Employer takes such risk in principle under FIDIC Red Book, Pink Book and Yellow Book.
- The obligations of parties are described in the following sections.
- The typical neutral events are:
  - 1) Unforeseeable physical conditions
  - 2) Force majeure
  - 3) Price escalation
  - 4) Change of legislation

## 4. Employer's Obligations under FIDIC Pink Book

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26

### Employer's Obligations under FIDIC Pink Book (1)

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Clause (MDB edition)	Obligations (Major Items Only)
1.6 Contract Agreement	Enter into a Contract Agreement with Contractor within 28 days Letter of Acceptance
1.13 Compliance with Laws	Obtain the planning, zoning or similar permission for Permanent Works
2.1 Right of Access to the Site	Give the Contractor right of Access to, and possession of the Site
2.4 Employer's Financial Arrangements	Submit reasonable evidence of financial arrangements to the Contractor
2.5 Employer's Claim	Give notice to the Contractor if the Employer considers to be entitled to any payment under the Contract
3.1 Engineer's Duties and Authority	Appoint the Engineer to carry out the duties assigned to him in the Contract
4.10 Site Data	Make available to the Contractor all relevant data in the Employer's possession on sub-surface and hydrological conditions at the Site, including environmental aspect
6.12 Foreign Personnel	Use best endeavors to assist the Contractor in connection with bringing in the Contractor's personnel
10.1 Taking Over of the Works and Sections	Take over the Works after Taking-Over Certificate has been issued by the Engineer

## Employer's Obligations under FIDIC Pink Book (2)

Clause (MDB edition)	Obligations (Major Items Only)
14.7 Payment	<ul style="list-style-type: none"> <li>• Make the advance payment</li> <li>• Pay the amount certified in each Interim Payment Certificate and Final Payment Certificate issued by the Engineer</li> </ul>
17.1 Indemnities	Indemnify and hold harmless the Contractor against and from all claims, damages, losses and expenses in respect of bodily injury, disease or death with is attributable to any negligence, willful act or breach of the Contract by the Employer.
19.2 Notice of Force Majeure	Give notice to the Contractor, if the Employer is, or will be prevented from performing the Employer's obligation by Force Majeure
20.2 Appointment of Dispute Board	Appoint the Dispute Board jointly with the Contractor

## *5. Contractor's Obligation under FIDIC Pink Book*

## Contractor's Obligations under FIDIC Pink Book (1)

Clause (MDB edition)	Obligations (Major Items Only)
1.6 Contract Agreement	Enter into a Contract Agreement with Contractor within 28 days after Letter of Acceptance
1.9 Delayed Drawings or Instructions	Give claim notice to the Engineer, if the Contractor suffers delay and/or incurs Cost due to delayed drawing or instruction
1.13 Compliance with Laws	Comply with applicable Laws
1.14 Joint and Several Liability	Be jointly and severally liable to the Employer, if the Contractor constitute JV
3.3 Instruction of the Engineer	Comply with the instructions given by the Engineer
4.1 Contractor's General Obligation	<ul style="list-style-type: none"> <li>Design (to the extent specified in the Contract), execute and complete the Works in accordance with Contract</li> <li>Be responsible for the adequacy, stability and safety of all Site operation and of all methods of construction</li> </ul>
4.2 Performance Security	Obtain a Performance Security and deliver to the Employer
4.4 Subcontractor	<ul style="list-style-type: none"> <li>Not to subcontract the whole of the Works</li> <li>Be responsible for the acts or defaults of Subcontractor</li> <li>Obtain prior consent of the Engineer to proposed Subcontractors not named in the Contract</li> </ul>
4.8 Safety Procedures	Comply with all applicable safety regulations

## Contractor's Obligations under FIDIC Pink Book (2)

Clause (MDB edition)	Obligations (Major Items Only)
4.9 Quality Assurance	Institute a quality assurance system and submit details to the Engineer
4.12 Unforeseeable Physical Conditions	Give claim notice to the Engineer, if the Contractor suffers delay and/or incurs Cost due to unforeseeable physical conditions
4.14 Avoidance of Interference	Not to interfere with the convenience of the public
4.15 Access Route	Use reasonable efforts to prevent any existing road or bridges from being damaged
4.18 Protection of the Environment	Take all reasonable steps to protect the environment
4.21 Progress Report	Prepare and submit monthly progress report to the Engineer
4.22 Security of the Site	Keep unauthorized person off the Site
4.24 Fossils	Give claim notice to the Engineer, if the Contractor suffers delay and/or incurs Cost due to discovery of fossils and other items of geological or archaeological interest
6.2 Rates of Wages and Conditions of Labour	Pay rates of wages and observe conditions of labour which are not lower than those established for trade or industry

## Contractor's Obligations under FIDIC Pink Book (3)

Clause (MDB edition)	Obligations (Major Items Only)
6.4 Labour Laws	Comply with all relevant labour laws
6.7 Health and Safety	<ul style="list-style-type: none"> <li>Take all reasonable precautions to maintain the health and safety of the Contractor's Personnel</li> <li>Appoint an accident prevention officer</li> <li>Send to the Engineer details of any accident</li> </ul>
6.10 Records of Contractor's Personnel and Equipment	Submit to the Engineer, details showing the number of each class of Contractor's Personnel and Equipment
7.3 Inspection	Give the Employer's Personnel the full opportunity to carry out inspections
7.5 Rejection	Make good defects notified by the Engineer
7.6 Remedial Works	Comply with the instructions of the Engineer with regard to remedial work
8.1 Commencement of Works	Commence the execution of the Works and proceed with the Works with due expedition and without delay
8.2 Time for Completion	Complete the Works within the time specified in the Contract
8.3 Programme	<ul style="list-style-type: none"> <li>Submit a detailed time programme to the Engineer</li> <li>Submit a revised programme whenever the previous programme is inconsistent with the actual progress</li> </ul>

## Contractor's Obligations under FIDIC Pink Book (4)

Clause (MDB edition)	Obligations (Major Items Only)
8.4 Extension of Time for Completion	Give claim notice to the Engineer, if the Contractor considers himself to be entitled to an extension of the Time for Completion
8.6 Rate of Progress	Adopt revised methods in order to expedite progress and complete the Works within the Time for Completion
8.7 Delay Damages	Pay delay damages in the case of failure to comply with the Time for Completion
9.1 Contractor's Obligation	Carry out Tests on Completion
11.1 Completion of Outstanding Work and Remedying Defects	Complete any work which is outstanding on the date stated in the Taking-Over Certificate
12.1 Works to be Measured	Assist the Engineer in making the measurement of the Works carried out
13.1 Right to Vary	Execute and be bound by each Variation instructed by the Engineer
13.7 Adjustments for Changes in Legislation	Give claim notice to the Engineer, if the Contractor suffers delay and/or incurs Cost due to changes in legislation
14.1 The Contract Price	Pay all taxes, duties and fees to be paid under the Contract

## Contractor's Obligations under FIDIC Pink Book (5)

Clause (MDB edition)	Obligations (Major Items Only)
14.2 Advance Payment	Submit an advance payment guarantee to the Employer
14.3 Application for Interim Payment Certificates	Submit a Statement to the Engineer for payment by the Employer
17.1 Indemnities	Indemnify and hold harmless the Employer against and from all claims, damages, losses and expenses in respect of bodily injury, disease or death with is attributable to any negligence, willful act or breach of the Contract by the Contractor.
17.2 Contractor's Care of the Works	<ul style="list-style-type: none"> <li>Take full responsibility for the care of the Works and Goods</li> <li>Rectify loss or damage, is any loss or damage happens to the Works, Goods or Contractor's Documents</li> </ul>
18.2 Insurance for Works and Contractor's Equipment	Whenever the Contractor is the insuring Party, The Contractor shall insure the Works, Plant, Materials and Contractor's Documents
18.3 Insurance against Injury to Persons and Damage to Property	Whenever the Contractor is the insuring Party, The Contractor shall effect and maintain Third Party Insurance
18.4 Insurance for Contractor's Personnel	The Contractor shall effect and maintain insurance against liability for claims, damages, losses and expenses arising from injury, sickness, disease or death of any person employed by the Contractor.

## Contractor's Obligations under FIDIC Pink Book (6)

Clause (MDB edition)	Obligations (Major Items Only)
19.2 Notice of Force Majeure	Give notice to the Employer, if the Contractor is, or will be prevented from performing the Employer's obligation by Force Majeure
20.1 Contractor's Claim	<ul style="list-style-type: none"> <li>Give notice to the Engineer if the Contractor considers himself to be entitled to any extension of the Time for Completion and/or any additional cost within 28 days</li> <li>Keep contemporary records as may be necessary to substantiate any claim</li> <li>Submit a fully detailed claim within 42 days to the Engineer</li> </ul>
20.2 Appointment of Dispute Board	Appoint the Dispute Board jointly with the Employer

## *6. Engineer's Roles and Obligations under FIDIC Pink Book*

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36

### Engineer's Roles

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The Engineer is not a contract party but his duties and authority are stipulated in the Contract and he plays an essential role in the contract administration process. The Engineer has three main functions in the administration of FIDIC Red/Pink Books:

- 1) Employer's agent
- 2) Independent engineer
  - (1) Certifier
  - (2) Decision maker in claim resolution



## Engineer's Role (1) : Employer's Agent

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- Reinforcement of Employer's technical and managerial capabilities for the project.
- The Engineer provides such services as:
  - 1) Examination of work program, method statement, and drawings submitted by the Contractor and giving approval/consent therefore
  - 2) Work progress management, cost management, quality management, inspection/testing, safety management and environmental management at the site.
  - 3) Instruction of Variation

## Engineer's Role (2) : Certifier

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- Issuance of various certificates regarding fulfilment of Contractor's obligation at his discretion
  - Interim Payment certificate
  - Final Payment certificate
  - Taking-over certificate
  - Performance certificate
- The certificate issued by the Engineer has a strong binding effect on both Employer and Contractor.

## Engineer's Role (3) : Decision Maker for Claims

- When a claim is raised by the Contractor or the Employer, the Engineer shall consult with each Party in an endeavor to reach agreement.
- If agreement is not achieved, the Engineer shall make a **fair determination** in accordance with the Contract, taking due regard of all relevant circumstances.
- Engineer's determination has binding effect to the parties until and unless such decision is revised by Dispute Board's decision.

## Engineer's Authorities

The Engineer shall exercise various authorities in contract administration, however, he shall obtain Employer's prior approval in some cases:

### 3.1 Obligaciones y Facultades del Ingeniero

The Engineer shall obtain the specific approval of the Employer before taking action under the following Sub-Clauses of these Conditions:

- (A) Sub-Clause 4.12: agreeing or determining an extension of time and/or additional cost.
- (B) Sub-Clause 13.1: instructing a Variation, except;
  - (i) in an emergency situation as determined by the Engineer, or
  - (ii) if such a Variation would increase the Accepted Contract Amount by less than the percentage specified in the Contract Data.
- (C) Sub-Clause 13.3: approving a proposal for Variation submitted by the Contractor in accordance with Sub-Clause 13.1 or 13.2.
- (D) Sub-Clause 13.4: specifying the amount payable in each of the applicable currencies

## *7. Claim and Dispute Resolution*

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### Types of Contractor's Claims

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- 1) Additional Cost
- 2) Extension of Time for Completion (EOT)

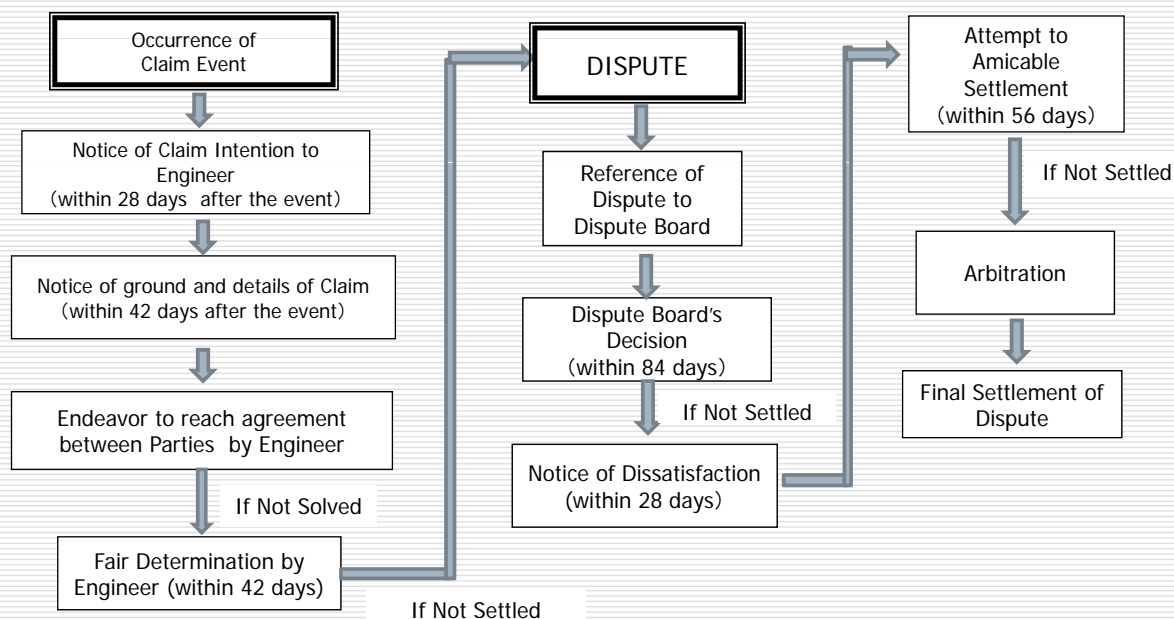
## Entitlement to Claim by the Contractor

Clause (FIDIC Red/Pink Book)		Cost	Time
1.9	Delayed Drawings or instructions	0	0
2.1	Right of Access to the Site	0	0
4.7	Setting Out	0	0
4.12	Unforeseeable Physical Conditions	0	0
4.24	Fossils	0	0
7.4	Testing	0	0
8.4	Extension of Time for Completion		0
8.5	Delay caused by authorities	0	0
8.9	Consequences of Suspension	0	0
10.2	Taking Over Parts of the Works	0	
10.3	Tests on Completion	0	0
11.8	Contractor to search	0	
12.4	Omissions	0	
13.7	Adjustments for Changes in Legislation	0	0
16.1	Contractor's Entitlement to Suspend Work	0	0
17.4	Consequences of Employer's Risks	0	0
19.4	Consequences of Forces Majeure	0	0

## Typical Claims/Disputes in Construction

- Possession of the Site (late hand-over of construction site to the Contractor)
- Unforeseen Physical Conditions
- New Unit Rate for Variation
- Late Payment to the Contractor
- Price Escalation

## Claim/Dispute Resolution Process (FIDIC Pink Book)



## 8. Important Aspects of Contract

## Important Aspects of Contract

### 1. Who designs the works?

	Design-Bid-Build type	Design-Build type
Design	Employer	Contractor
Construction	Contractor	Contractor
Payment method	Unit-price (re-measurement)	Lump sum
Payment timing	Monthly (based on work progress)	Milestone (based on completion of part of the Works)
Risk for work quantity estimate	Employer	Contractor
Typical conditions of contract	FIDIC Red Book FIDIC Pink Book	FIDIC Yellow Book FIDIC Silver Book

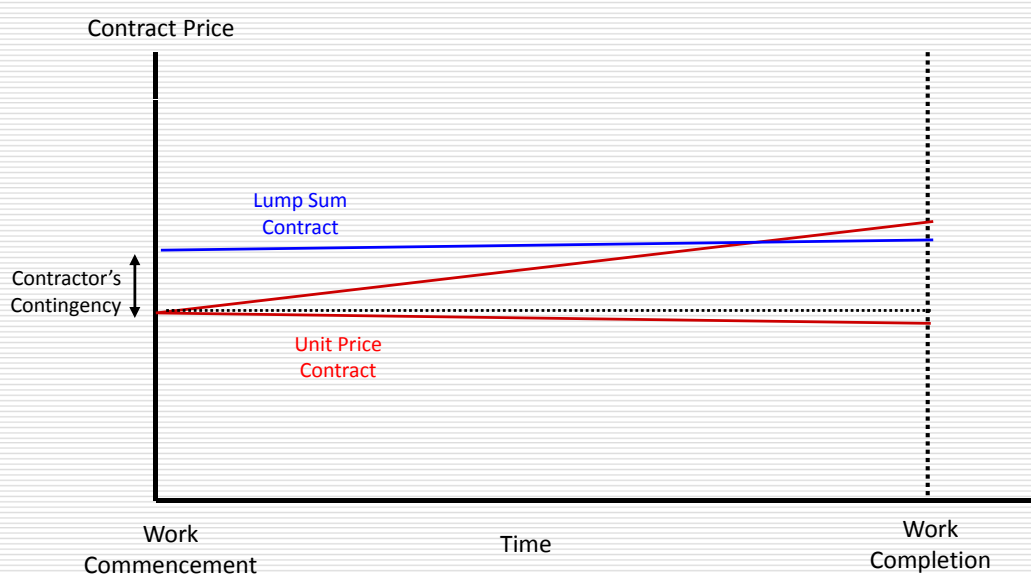
## Important Aspects of Contract

### 2. Unit-price or Lump Sum

Unit Price Contract	Lump Sum Contract
<ul style="list-style-type: none"> <li>• The work quantities in “Bill of Quantities (Price Schedule) are estimated by the Employer based on his design and these quantities are provisional.</li> <li>• Payment is made based on actual work quantities periodically (usually monthly).</li> <li>• Unit prices are quoted by the Contractor and he shall be responsible for unit prices.</li> </ul>	<ul style="list-style-type: none"> <li>• Lump sum payment is usually used in Design-Build contract, because only Contractor can estimate work quantities based on his design.</li> <li>• The Contractor takes a risk for accuracy of the work quantity.</li> <li>• The Contractor includes contingency in his bid price to cover such risk usually.</li> <li>• In case actual/final work quantities are difficult to be estimated by anyone, lump-sum contract is not suitable.</li> <li>• Actual work quantities are not measured during construction and payment is made on milestone basis.</li> </ul>

## Important Aspects of Contract

### 2. Unit-price or Lump Sum (continued)



## Important Aspects of Contract

### 3. Unforeseeable Underground Conditions

FIDIC Red Book, Pink Book and Yellow Book entitle the Contractor to claim when he has encountered unforeseeable physical conditions.

#### 4.12 Unforeseeable Physical Conditions

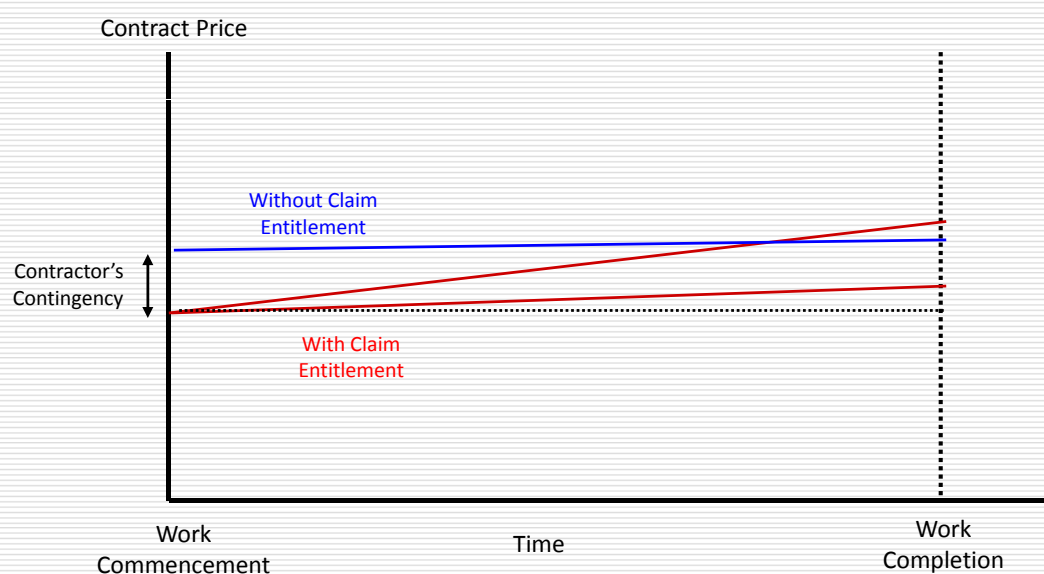
In this Sub-Clause, "physical conditions" means natural physical conditions and man-made and other physical obstructions and pollutants, which the Contractor encounters at the Site when executing the Works, including **sub-surface** and hydrological conditions but excluding climatic conditions.

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If and to the extent that the Contractor encounters physical conditions which are Unforeseeable, gives such a notice, and suffers delay and/or incurs Cost due to these conditions, the Contractor shall be entitled subject to notice under Sub-Clause 20.1 [Contractor's Claims] to:

- (a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [ Extension of Time for Completion ], and
- (b) payment of any such Cost, which shall be included in the Contract Price.

## Important Aspects of Contract

### 3. Unforeseeable Geological Conditions (continued)



## Important Aspects of Contract

### 4. Variation

When unforeseeable physical conditions is encountered, Variation is a effective solution to overcome difficulties. FIDIC Pink Book stipulates:

#### 13.1 Right to Vary

Variations may be initiated by the Engineer at any time prior to issuing the Taking-Over Certificate for the Works, either by an instruction or by a request for the Contractor to submit a proposal..

Each Variation may include:

- (a) changes to the quantities of any item of work included in the Contract (however, such changes do not necessarily constitute a Variation),
- (b) changes to the quality and other characteristics of any item of work,
- (c) changes to the levels, positions and/or dimensions of any part of the Works,
- (d) omission of any work unless it is to be carried out by others,
- (e) any additional work, Plant, Materials or services necessary for the Permanent Works, including any associated Tests on Completion, boreholes and other testing and exploratory work, or
- (f) changes to the sequence or timing of the execution of the Works.



## *9. Discussions*

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### Which Payment Method for LC Project?

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1. Payment based on operation time (day or hour) of drilling equipment
  - widely used for drilling works
  - less claim for unforeseeable underground conditions
  - contractor's inefficient operation should not be allowed
  - close monitoring and supervision of contractor's drilling work by Employer/Engineer required
2. Payment based on drilling length(meter)
  - sometimes used for drilling works
  - risk of underground conditions should be clearly demarcated for smooth settlement of claim
3. Payment on lump sum basis
  - rarely used due to very high risk to the contractor (high contract price)

## Contract Packaging for LC Project?

---

### 1. Multiple Package

- 1) Package 1 : Supply of Drilling Materials
- 2) Package 2 : Drilling Works

### 2. One Package Contract for Materials and Drilling Work

## Laguna Colorada Geothermal Project

### Workshop 1

## Procurement under JICA ODA Projects

March 2015

Cochabamba, Bolivia

JICA Study Team

Nippon Koei Co., Ltd.

## 第二回セミナー資料

# Laguna Colorada Geothermal Project

## Seminar 2

# Program of Seminar

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March 2015

Cochabamba, Bolivia

JICA Study Team

Nippon Koei Co., Ltd.

2

## Program of Seminar

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1. Study of Market Trend of Well Drilling Companies
2. Results of Technical Review of Laguna Colorada Geothermal Field
3. Suitable Drilling Contract for the Project
4. Discussion

# Laguna Colorada Geothermal Project Workshop 2

## Marketing Study of Drilling Services Companies

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March 2015

Cochabamba, Bolivia

JICA – Study Team

Nippon Koei Co., Ltd.

2

## Index

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1. Objectives
2. Methodology
3. Aspects to Evaluate
4. Tool for the Study
5. List of Company
6. Services Offered
7. Type of Contracts

# 1. Objectives

---

- a) Verify the intention and availability of Bolivian drilling services companies, to participate in a bidding process for Laguna Colorada Project. Especially directed for the Drilling Companies.
- b) Verify the type of contract used for drilling services in oil and gas industry.
- c) Verify if there is any possibility to have a Footage or Turn Key contract for the project.

# 2. Methodology

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- **Type of Interviews:** face to face in the offices of the companies.
- **Lugar:** Santa Cruz de la Sierra, Bolivia.
- **Period:** from February 9 to 20 and from march 23 to 24 of 2015.
- **Total of Companies Interviewed:** 11 drilling services companies.
- **Tool Used:** Questionnaire 1 and 2

### 3. Aspects to Evaluate

- Intention and Availability to participate in the bidding process
- Type of contract used for the services
- Services offered (RIG and/or Complement Services)
- Experiences on geothermal wells drilling
- Type of Drilling RIG

### 4. Tools Used for the Study

#### Questionnaire 1

- a) Name of the Company: \_\_\_\_\_
- b) Name of the Contact:
  - Name: \_\_\_\_\_
  - Position: \_\_\_\_\_
- c) Mention the main activity of the Company: \_\_\_\_\_
- d) How many Drilling Rigs have in operation in Bolivia? \_\_\_\_\_
- e) What is the capacity of the Drilling Rigs (Hp, Hook Load)? Complete Questionnaire 2
  - RIG 1: \_\_\_\_\_
  - RIG 2: \_\_\_\_\_
  - RIG 3: \_\_\_\_\_
- f) What kinds of other drilling services offer for well drilling? \_\_\_\_\_
- g) What is the type of contract that is more usually to offer your service?
  - Daily Rent: \_\_\_\_\_
  - Footage: \_\_\_\_\_
  - Turn Key (Lump Sum): \_\_\_\_\_
  - Integrated Drilling Contract: \_\_\_\_\_
  - Other: \_\_\_\_\_
- h) Do you have experience in geothermal field drilling? \_\_\_\_\_
- i) If you have experience in geothermal field drilling, mention the name of the geothermal fields where you have participated and the depths of the wells drilled. \_\_\_\_\_
- j) Do you have personnel with experience in geothermal field drilling? \_\_\_\_\_
- k) Could you share a copy of a drilling contract that you normally use for these services? \_\_\_\_\_

## 5. List of Companies Interviewed

## 6. Servicios que Ofrecen

Company	RIG	Direct.	Cement.	Mud Logging	Wire Line / Well Logging	Casing Running	Fishing Tools/Rent	Integrated Services	Tools Rent	Solid Control	Other Services
A	X	X	X	-	-	-	X	X (Consult)	-	-	X
B	-	X	X	X	X	X	X	X	X	X	X
C	-	X	X		X	X	-	-	-	-	X
D	-	X	X	X	X	X	X	X (Consult)	X	-	X
E	-	-	-	X	-	-	-	-	-	-	X
F	-	X	X	-	-	X	-	-	X	X	X
G	-	X	-	X	X	X	-	-	-	-	X
H	X	X	-	-	-	-	-	-	X	X	X
I	X (Peq.)	-	-	-	X	-	-	X (Consult)	-	-	X
J	-	-	-	X	-	-	-	-	X	X	X
K	X	-	-	-	-	-	-	-	-	-	-
L	X	-	-	-	-	-	-	-	-	-	-



## 7. Type of Contract

---

No	COMPANY	Intention and Availability to Participate in the Bidding	Type of Contract			
			Daily Rent	Footage	Turn Key	Integrated Services
1	A	Yes	X	-	-	X
2	B	Yes	X	-	-	X (Consult)
3	C	Yes	X	-	-	X (Consult)
4	D	Yes	X	-	-	-
5	E	Yes	X	-	-	-
6	F	Yes	X	-	-	-
7	G	Yes	X	-	-	X (Consult)
8	H	Yes	X	-	-	-
9	I	Yes	X	-	-	-
10	J	Yes	X	-	-	-
11	K	Yes	X	-	-	-
12	L	Yes	X	-	-	-

## Laguna Colorada Geothermal Project Workshop 2

### Marketing Study of Drilling Services Companies

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March 2015

Cochabamba, Bolivia

JICA – Study Team

Nippon Koei Co., Ltd.

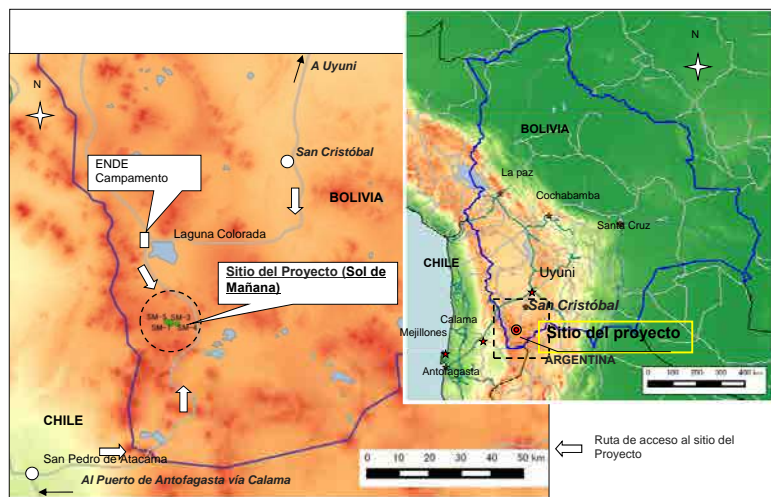
ASISTENCIA ESPECIAL PARA LA IMPLEMENTACIÓN DEL PROYECTO  
(SAPI)  
PARA EL PROYECTO DE CONSTRUCCIÓN DE LA PLANTA  
GEOTÉRMICA LAGUNA COLORADA  
(FASE 1 DE LA PRIMERA ETAPA)

Review of existing reports and  
available information of Laguna  
Colorada Geothermal Project

26 March 2015

EQUIPO DE ESTUDIO DE JICA

STUDY AREA



## CONTENTS

- Data collection
- Geology
- Geophysical study
- Geothermal Reservoir
- Plans for new wells
- Drilling wells (Case study)

## 1. DATA COLLECTION

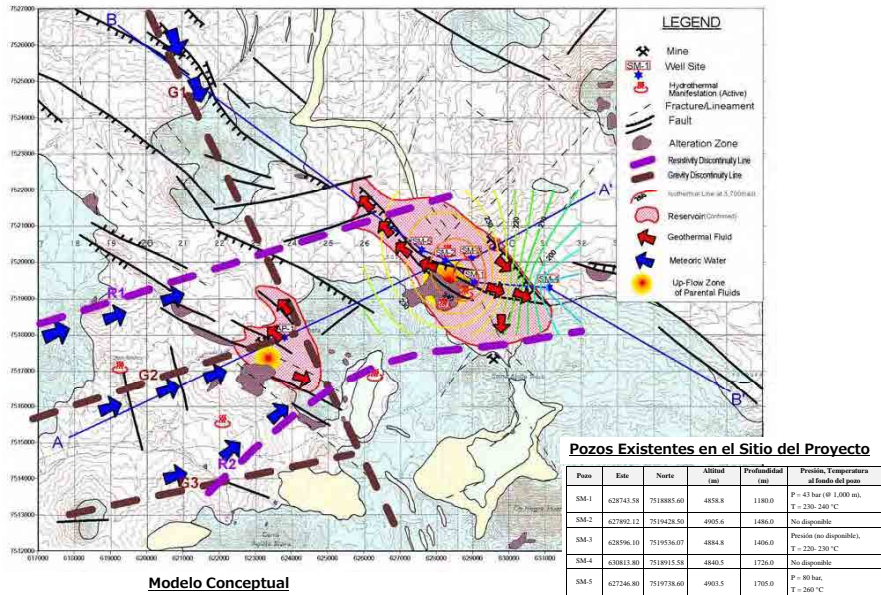
### Availability of existing information

- ENEL (1989) Estudio de Factibilidad Geotérmica en el Area de Laguna Colorada - INFORME SOBRE EL POZO SOL DE MAÑANA 1~3
- ENEL (1990) Estudio de Factibilidad Geotérmica en el Area de Laguna Colorada - INFORME SOBRE EL POZO SOL DE MAÑANA 4
- ENDE (1994) PROYECTO GEOTERMICO LAGUNA COLORADA AMPLIACION DE PERFORACIONES GEOTERMICAS - PROFUNDIZACION DEL POZO SOL DE MAÑANA -4 (SM -4)
- ENDE (1994) PROYECTO GEOTERMICO LAGUNA COLORADA AMPLIACION DE PERFORACIONES GEOTERMICAS - PROFUNDIZACION DEL POZO SOL DE MAÑANA -5 (SM -5)
- Estudio de Factibilidad para la Construcción de la Planta Geotermoeléctrica de Laguna Colorada Potosi, Bolivia (2008, West-jec)
- ESTUDIO PREPARATORIO PARA EL DESARROLLO GEOTÉRMICO DE LAGUNA COLORADA (SOL DE MAÑANA) Informe Final (2010, West-Jec)
- Proyecto Preparatorio para el Proyecto Construcción de la Central Geotérmica de Laguna
- Colorada Informe Final (2013, West-jec)

### We reviewed the following data:

- Datos de estudios de Gravedad (ENDE, 1986)
- Datos de estudios geoquímicos (Weat Jec, 2008)
- Datos de test de producción (Weat Ject, 2012)
- Datos de estudios de MT (ENDE, 2013)

## 2. GEOLOGY



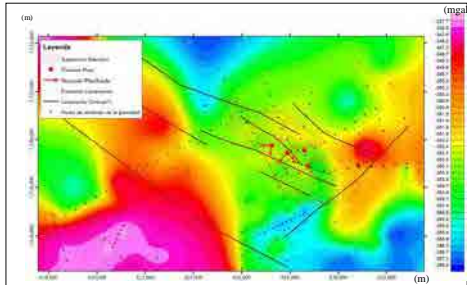
Fuente: Informe del Estudio Preparatorio de JICA (2010)

Fuente: RFP, Informe de Sol Mañana (ENEL, 1989)

## 3. GEOPHYSICAL STUDY

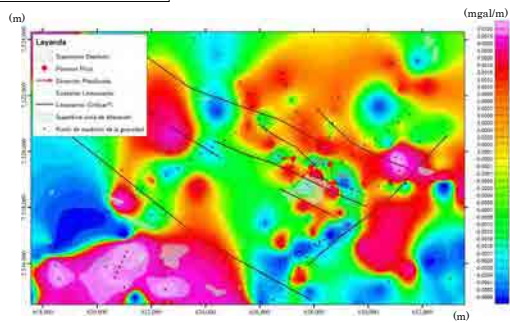
- In 2013, ENDE conducted 63 MT survey with 63 points in the Project site.
- The results of the study of 3D inversion MT are available for evaluating the geothermal reservoir.
- Because the results of MT survey in previous studies is not compiled, we have begun to analyze data and interpret MT geothermal reservoir structure, in order to compare with the previous study.
- According to the preliminary review of the MT survey, low resistivity areas are altered ignimbrite and some faults were identified.

### 3-1 GEOPHYSICAL SURVEY (GRAVITY SURVEY)

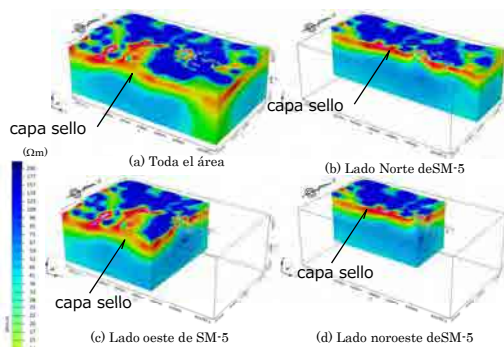
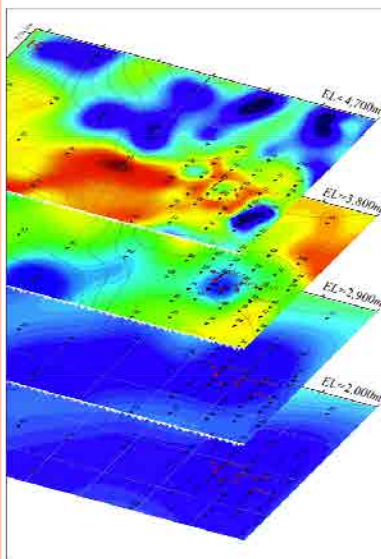


Resultados del estudio de gravitatorio  
**Anomalia gravitatoria**

Fuente: Preparado por por Equipo de estudio de Jica sobre la base de los datos de registro de perforaciones de ENEL 1989



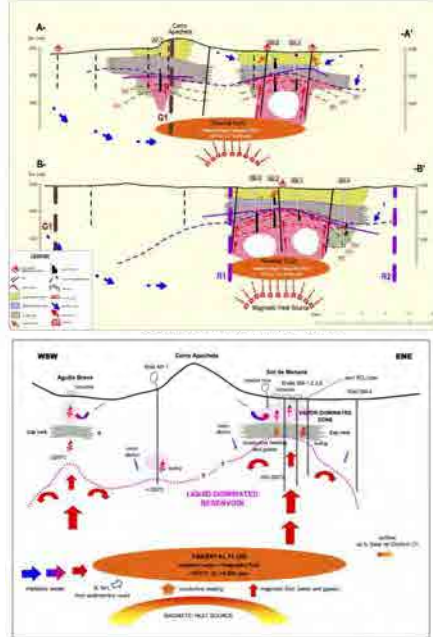
### 3-2. GEOPHYSICAL SURVEY (MT SURVEY)



Diagramación del panel del Modelo de Inversión en 3D

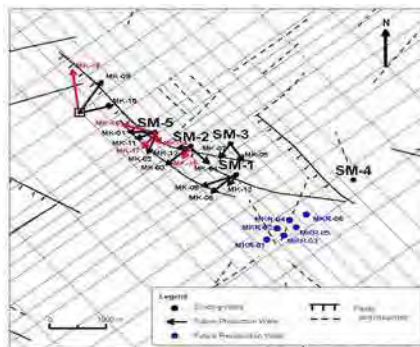
Fuente: Preparado por Equipo de estudio de Jica sobre la base de los datos del estudio MT provenientes de CGG 2013

## 4. GEOTHERMAL RESERVOIR



Based on the results of the geophysical survey and wells, a “cap rock impermeable rock” was inferred between the main reservoir and the shallow aquifer feeding the hydrothermal manifestations. (JICA 2010)

## 5. PLANES PARA NUEVOS POZOS



NO se determinaron Pozos objetivo NO fuers y el Diseño del Pozo NO fue llevado a cabo en los informes existentes.

- Desviación ???
- KOP ???
- Azimuth ???
- Desplazamiento Horizontal?

Plan de Perforación de Pozos para la Fase Primaria de la Etapa 1

Tipo	Pozo No.	Ubicación de la Plataforma	Prof. (m)	Programa de Revestimiento
Pozos de Producción	MK- 01	SM- 5	2000	0 – 30 m: Conductor (20”), 94 lb/pie, K-55
	MK- 02	SM- 5	2000	0 – 400 m: Superficie (13- <sup>3</sup> / <sub>8</sub> ”), 68 lb/pie, K-55
	MK- 03	SM- 2	2000	0 – 1,000 m: Producción (9- <sup>5</sup> / <sub>8</sub> ”), 47 lb/pie, N-80
	MK- 04	SM- 2	2000	1,000 – 2,000 m: Tubería ranurada (7”), 26 lb/pie, K-55
Pozos de Reinyección	MKR- 01	Plataforma nueva	1500	0 – 30 m: Conductor (20”), 94 lb/pie, K-55
	MKR- 02	Plataforma nueva	1500	0 – 300 m: Superficie (13- <sup>3</sup> / <sub>8</sub> ”), 68 lb/pie, K-55
	MKR- 03	Plataforma nueva	1500	0 – 800 m: Producción (9- <sup>5</sup> / <sub>8</sub> ”), 47 lb/pie, N-80 800 – 1,500 m: Tubería ranurada (7”), 26 lb/pie, K-55

Fuente: Informe del Estudio Preparatorio de JICA (2010)

## 6. WELL DRILLING (CASE STUDY)

- Drilling schedule is roughly estimated by using existing 5 well data.
- Condition of new drilling wells (provisional)
  - kick-off point
    - Production well: 400 m
    - Re-injection well 350 m
  - Directional drilling 30 degrees
  - The progress of the drilling direction is 80% -85% of the vertical drilling.

### 6-1. SUMMARY OF 5 EXISTING WELLS

SECCION DEL POZO	SM-1	SM-2	SM-3	SM-4	SM-5
Profundidad	1178.5m	1488.5m	1408.0m	1728.2m 31147.0~1728.0m Perforación Adicional	1705.0m
Periodo	70 días (Sep. 8, 1988 ~ Nov. 15, 1988)	61 días (Dec. 18, 1988 ~ Feb. 17, 1989)	72 días (Apr. 21, 1989 ~ Oct. 5, 1989) 89 días (Jun. 16, 1988 ~ Sep. 19, 1988) Parado ingeniería	87 días 53 días (Nov. 1, 1989 ~ Dec. 24, 1989) 39 días (Nov. 28, 1991 ~ Dec. 18, 1991)	89 días (Apr. 3, 1992 ~ Nov. 8, 1992) 131 días (Jun. 1, 1992 ~ Oct. 1, 1992) Parado Ingeniería
Díametro del Pozo	24"				
Sección de Perforación	0.0 ~ 75.0m 3875.0m	0.0 ~ 72.0m 3872.0m	0.0 ~ 63.0m 3863.0m	0.0 ~ 61.0m 3861.0m	0.0 ~ 70.0m 3870.0m
Tamaño del tubo (conducto)	20"				
Sección del tubo	0.0 ~ 69.0m 3869.0m	0.0 ~ 69.5m 3869.5m	0.0 ~ 58.0m 3858.0m	0.0 ~ 58.8m 3858.8m	0.0 ~ 69.85m 3869.85m
Periodo	13 días (Sep. 8, 1988 ~ Sep. 20, 1988)	10 días (Dec. 18, 1988 ~ Dec. 28, 1988)	14 días (Apr. 21, 1989 ~ May. 4, 1989)	9 días (Nov. 1, 1989 ~ Nov. 6, 1989)	10 días (Apr. 3, 1992 ~ Apr. 12, 1992)
día/m	<b>0.178 día/m</b>	<b>0.138 día/m</b>	<b>0.222 día/m</b>	<b>0.098 día/m</b>	<b>0.143 día/m</b>
<b>Promedio</b>	<b>0.155 día/m</b>				
Díametro del Pozo	17-1/2"				
Sección de Perforación Int.	75.0 ~ 307.0m 3822.0m	72.0 ~ 310.5m 3828.5m	63.0 ~ 305.0m 3842.0m	61.0 ~ 301.0m 3840.0m	70.0 ~ 300.0m 3820.0m
Tamaño del tubo (superficial)	19-3/8"				
Sección del Tubo (m)	0.0 ~ 302.7m 3802.7m	0.0 ~ 308.0m 3808.0m	0.0 ~ 288.0m 3828.0m	0.0 ~ 297.2m 3827.2m	0.0 ~ 295.0m 3825.0m
Periodo	15 días (Sep. 21, 1988 ~ Oct. 5, 1988)	17 días (Dec. 20, 1988 ~ Jan. 14, 1989)	17 días (May. 5, 1989 ~ May. 21, 1989)	11 días (Nov. 7, 1989 ~ Nov. 17, 1989)	14 días (Apr. 13, 1992 ~ Apr. 26, 1992)
día/m	<b>0.085 día/m</b>	<b>0.071 día/m</b>	<b>0.070 día/m</b>	<b>0.046 día/m</b>	<b>0.061 día/m</b>
<b>Promedio</b>	<b>0.063 día/m</b>				
Díametro del Pozo	17-1/2"				
Sección de Perforación Int.	307.0 ~ 742.0m 3845.0m	310.5 ~ 617.0m 3836.5m	305.0 ~ 738.0m 3843.0m	301.0 ~ 687.0m 3888.0m	300.0 ~ 800.0m 3860.0m
Tamaño del tubo (Productivo)	9-5/8"				
Sección del Tubo (m)	0.0 ~ 738.0m 3873.0m	0.0 ~ 608.0m 3868.0m	0.0 ~ 731.0m 3871.0m	0.0 ~ 297.2m 3863.2m	0.0 ~ 878.3m 3883.3m
Periodo	27 días (Oct. 5, 1988 ~ Oct. 31, 1988)	14 días (Jan. 15, 1989 ~ Jan. 29, 1989)	25 días (May. 22, 1989 ~ Jun. 15, 1989)	13 días (Nov. 18, 1989 ~ Nov. 30, 1989)	41 días (Apr. 27, 1992 ~ Oct. 15, 1992)
día/m	<b>0.088 día/m</b>	<b>0.046 día/m</b>	<b>0.088 día/m</b>	<b>0.034 día/m</b>	<b>0.088 día/m</b>
<b>Promedio</b>	<b>0.053 día/m</b>				
Díametro del Pozo	8-1/2"				
Sección de Perforación Int.	762.0 ~ 1178.5m 38415.0m	617.0 ~ 1488.5m 38688.0m	738.0 ~ 1408.0m 38670.0m	687.0 ~ 1728.2m 38652.0m	900.0 ~ 1705.0m 38615.0m
Tamaño del tubo (Slotted Liner)	7"				
Sección del Tubo (m)	31052.0m				
Periodo	15 días (Nov. 1, 1988 ~ Nov. 15, 1988)	20 días (Jan. 28, 1989 ~ Feb. 17, 1989)	18 días (Sep. 20, 1989 ~ Oct. 5, 1989)	42 días (Dec. 1, 1989 ~ Dec. 31, 1989) (Nov. 28, 1991 ~ Dec. 18, 1991)	24 días (Oct. 16, 1992 ~ Dec. 8, 1992)
día/m	<b>0.038 día/m</b>	<b>0.023 día/m</b>	<b>0.024 día/m</b>	<b>0.040 día/m</b>	<b>0.030 día/m</b>
<b>Promedio</b>	<b>0.031 día/m</b>				

## 6-2. ESTIMATED DRILLING SCHEDULE FOR NEW WELLS

Item	tipo de pozo	Production Well	Injection Well
<b>Profundidad de la Perforación</b>		<b>2000m</b>	<b>1500m</b>
<b>1st Section</b>	diametro del pozo	26"	
	profundidad de la perforación	35m	
	tamaño del tubo (conductor)	20"	
	sección del tubo	0 ~ 30m (30m)	
	día/m	0.155 día/m	
<b>Periodo de Estimación</b>		<b>6 días</b>	
<b>2nd Section</b>	diametro del pozo	17-1/2"	
	profundidad de la perforación	35~405m (370m)	35~305m (270m)
	tamaño del tubo (superficie)	13-3/8"	
	sección del tubo	0~400m (400m)	0~300m (300m)
	día/m	0.063 día/m	
<b>Periodo de Estimación</b>		<b>24 días</b>	<b>17 días</b>
<b>3rd Section</b>	diametro del pozo	12-1/4"	
	profundidad de la perforación	405~1005m (600m)	305~805m (500m)
	punto de inicio	450m	350m
	Inclinación de la Perforación Direccional	30°	30°
	Tasa de prima de perforación Direccional	15%	
	tamaño del tubo (producción)	9-5/8"	
	sección del tubo	0~1000m (1000m)	250~800m (550m)
día/m	0.053 día/m		
<b>Periodo de Estimación</b>		<b>37 días</b>	<b>31 días</b>
<b>4th Section</b>	diametro del pozo	8-1/2"	
	profundidad de la perforación	1005~2000m (995m)	805~1500m (695m)
	Inclinación de la Perforación Direccional	30°	30°
	Tasa de prima de perforación Direccional	15%	
	tamaño del tubo (Tubería Ranurada)	7"	
	sección del tubo	950~2000m (1050m)	750~1500m (750m)
día/m	0.031 día/m		
<b>Periodo de Estimación</b>		<b>36 días</b>	<b>25 días</b>
<b>periodo total de estimación</b>		<b>103 días</b>	<b>79 días</b>

## 6-3. RESULTS OF THE CASE STUDY

Item	tipo de pozo	Pozo de Producción	Pozo de Inyección
El plan actual de periodo de perforación		90 días aprox.	60 días aprox.
periodo de estimación		103 días	79 días

- The shortage of water supply for drilling and significantly affects the work schedule.
- At least 40 L / sec fresh water supply will be necessary to carry out drilling without problems. From the fresh water supply of an existing well is 7L / sec, therefore, about 5 additional wells for water are required.



## SITE INSPECTION 19-20 MAR



Access road to the Project Site



AP-1



Existing Well SM-5



Sol de Mañana Project Site



Sol de Mañana Project Site



Existing well SM-1



Well for Water Supply



Existing well SM-4 (Reinjection well)

**Muchas Gracias**



# Laguna Colorada Geothermal Project

## Workshop 2

### Drilling Contract to be Suitable for the Project

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March 2015

Cochabamba, Bolivia

JICA Study Team

Nippon Koei Co., Ltd.

2

## Type of Payment

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Among three (3) types of payment methods (namely "Daily", "Footage" and "Lump Sum (Turnkey)"), "Footage" payment is considered to be the most favorable to the Owner. However, the result of market survey shows that all the contractors interviewed are negative to accept "Footage" payment due to high exposure of the geological risks and they are very positive to accept "Daily" payment. As a result, we can not ignore such Contractor's view to avoid such situation as no competent bidder participates in the bid.

#### **Considerations:**

- "Daily" payment,
  - the Contractor's risk for execution of works is very limited, because he is paid on time basis (drilling time and also idling time) but not on actual achievement of his work.
  - the Employer shall make close supervision of Contractor's work at the Site to avoid inefficient work and to make proper instructions to the Contractor, especially when the Contractor encounters unforeseeable events.

## Type of Payment

---

- The “unforeseeable” means not reasonably foreseeable by an experienced contractor at the time of bidding.
- Unforeseeable events includes:
  - lost circulation
  - well collapse
  - blow out
  - stuck pipe
  - fishing tools
- the Contractor is not encouraged to complete the works earlier, since the payment is made on time basis.
- however, less contractual claim by the Contractor is anticipated, since additional cost caused by disruption of works will be automatically compensated by the actual time payment.

## Type of Payment

---

- “Footage” payment
  - more well-balanced risk allocation of geological risk between the Employer and the Contractor can be realized.
  - it boosts Contractor’s incentive motivation for early completion of works, and this is beneficial to the Employer also.
  - When the drilling work is obliged to be delayed or suspended by the unforeseeable events, a different payment method (for example “Daily” payment) will be applied to compensate such adverse effect to the work.
  - This hybrid payment system reduces the Contractor’s risk to the reasonable extent and avoids unreasonably high bid price which is also beneficial to the Employer.

## Type of Payment

- “Lump Sum” payment
  - “Lump Sum” payment is rarely used for deep drilling works, since the Contractor has to take huge geological risk for which nobody can foresee.
  - Under the “Lump Sum” contract arrangement, the Employer has to take such risk as:
    - No bidder participates in a bid.
    - Even some bidder participates in a bid, his bid price will be very high so as to cover all unforeseeable risk events. If such risk events are not taken place, the Employer pays more than necessary consequently.

## Conditions of Contract

FIDIC Pink Book (Conditions of Contract for Construction for Building and Engineering Works designed by the Employer) is recommended to be used as a conditions of contract for drilling works of the Project.

### Considerations:

- Internationally accepted conditions of contract shall be used in the international bidding to attract bidders.
- FIDIC Pink Book has been used by Multilateral Development Banks including World Bank and Inter-American Development Bank as well as JICA in their Standard Bidding Documents.
- IADC (International Association of Drilling Contractors) model contract is another candidate. However, substantial amendment of contract clauses is required since many of the clauses are deemed to be favorable to the Contractor.

# Contract Packaging

The following contract packaging is proposed for the Project.

## A. Contracts self finance by ENDE ANDINA

- 1) Rig platform preparation
- 2) Access Road
- 3) Water Supply System (water well and piping to rigs)

## B. Contacts financed under JICA ODA Loans

- 1) Material Supply Contract
  - Fluid Materials: Bentonite and Chemical additives (can be included in Mud Engineering)
  - Drilling Bits
  - Casing
  - Wellhead Equipment and Accessories: Master valves, lateral valves, casing head, Expansion Spool, etc.
  - Casing Accessories: Shoes, Float Collars, etc.
  - Others.

# Contract Packaging

## 2) Drilling Works Contract with associated services

- Drilling (RIG)
- Directional Drilling
- Mud Logging: Drilling Parameter and Cutting Control (Geology)
- Mud Engineering (may include Fluid Materials)
- Wire Line /Well Logging
- Casing Running
- Fishing tools and service
- Drilling Tools Rental
- Coring
- Non Rotate Casing Protectors
- Transportation of Mterials
- Dewatering System
- Others

# Contract Packaging

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## Considerations:

- Providers of drilling materials and drilling services are different entities in principle.
- Regarding drilling service, it is better to minimize numbers of contract package in order to reduce Employer's administrative overburden and interfacing issue between contract packages.

## Laguna Colorada Geothermal Project

### Workshop 2

## Drilling Contract to be Suitable for the Project

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Cochabamba, Bolivia

JICA Study Team

Nippon Koei Co., Ltd.