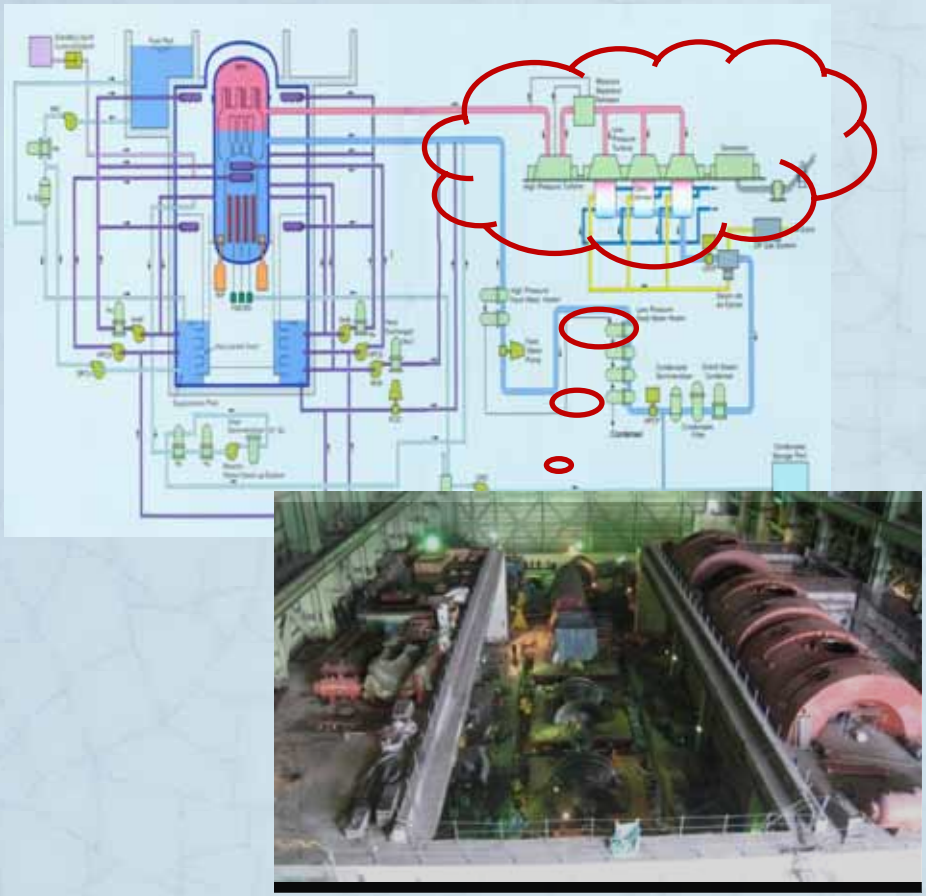
核能四廠安全監督委員會第2屆第8次會議
汽機廠房－汽輪發電機安裝現況



現場巡查前簡報(1)

簡報人：
龍門施工處
汽機組 鄧志宏

簡報項目

- 壹、核四廠汽輪發電機設備簡介
- 貳、汽輪機裝機流程圖
- 參、汽輪機裝機示意圖及照片

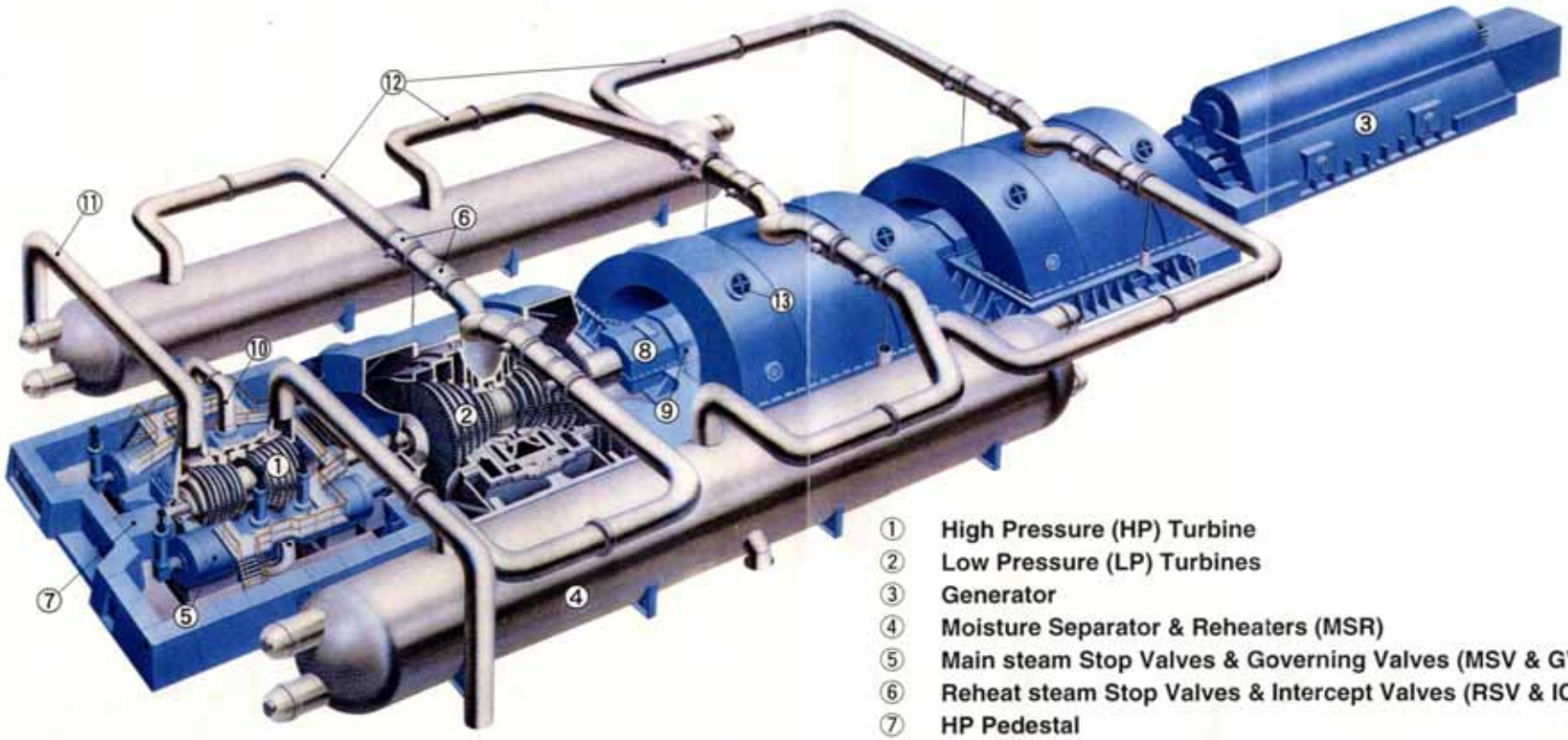
簡報結束

敬請指教

壹、核四廠汽輪發電機安裝－設備簡介

- 汽機型式 ： 日本三菱重工TC6F-46
- 汽機組成 ： 高/低壓汽機串聯複合；一高壓三低壓，軸向雙流
- 轉子型式 ： 全鍛式(MONOBLOCK)
- 額定容量 ： 1,369MW(發電機輸出端)
- 最大出力 ： 1,405MW(於反應爐功率為105%時)
- 汽機轉速 ： 1,800 RPM (60Hz)
- 進汽壓力 ： 6.79MPa(Abs)
- 進汽溫度 ： 283.8℃
- 排汽壓力 ： 715.5mmHg(Vac)
- 高壓抽汽 ： 第3級與第5級葉片共兩處抽汽
- 低壓抽汽 ： 第2、3、5和6級葉片共四處抽汽
- MSR型式 ： Chevron型汽水分離，雙級再熱器

Mitsubishi Nuclear Steam Turbine



① High Pressure (HP) Turbine
② Low Pressure (LP) Turbines
③ Generator
④ Moisture Separator & Reheaters (MSR)
⑤ Main steam Stop Valves & Governing Valves (MSV & GV)
⑥ Reheat steam Stop Valves & Intercept Valves (RSV & ICV)
⑦ HP Pedestal
⑧ Thrust Bearing
⑨ Journal Bearings
⑩ Main Steam Inlet Pipes
⑪ Low Temperature Reheat Steam Pipes (Cross Under Pipes)
⑫ Hot Temperature Reheat Steam Pipes (Cross Over Pipes)
⑬ Rupture Discs

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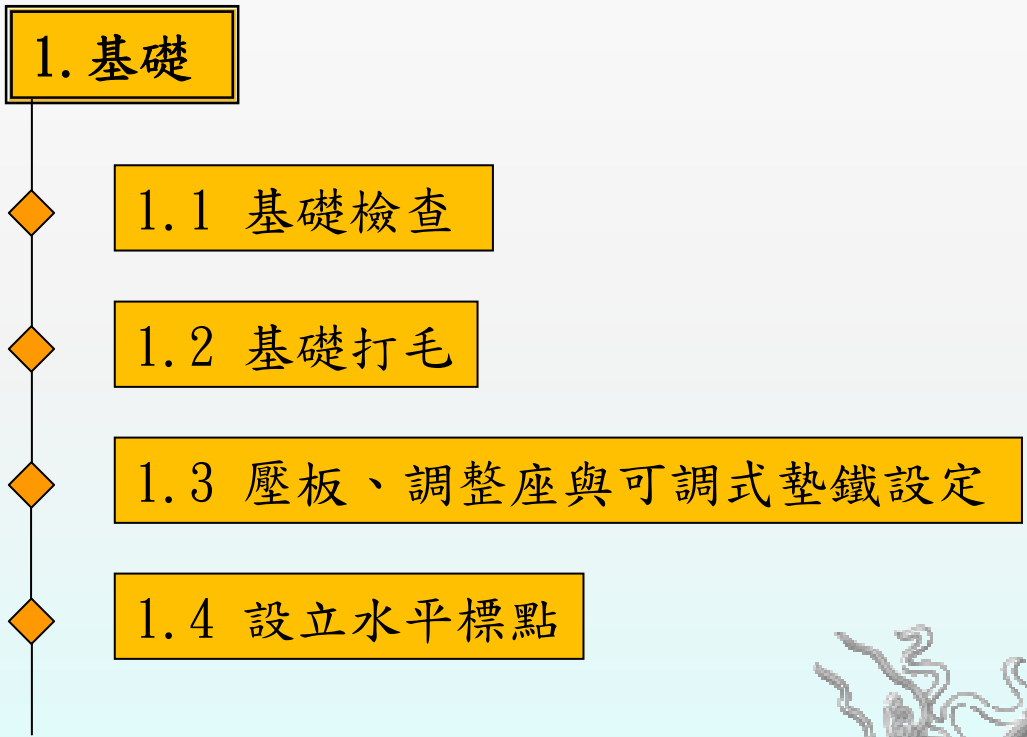
龍門主汽機係日本MHI承製，串聯複合六流排汽再熱式汽輪機(Tandem Compound 6-Exhaust Flows Condensing Reheat Turbine；一高壓、三低壓)，位在汽機廠房頂樓 EL 30500mm

貳、核四廠汽輪發電機安裝步驟

二、安裝流程圖



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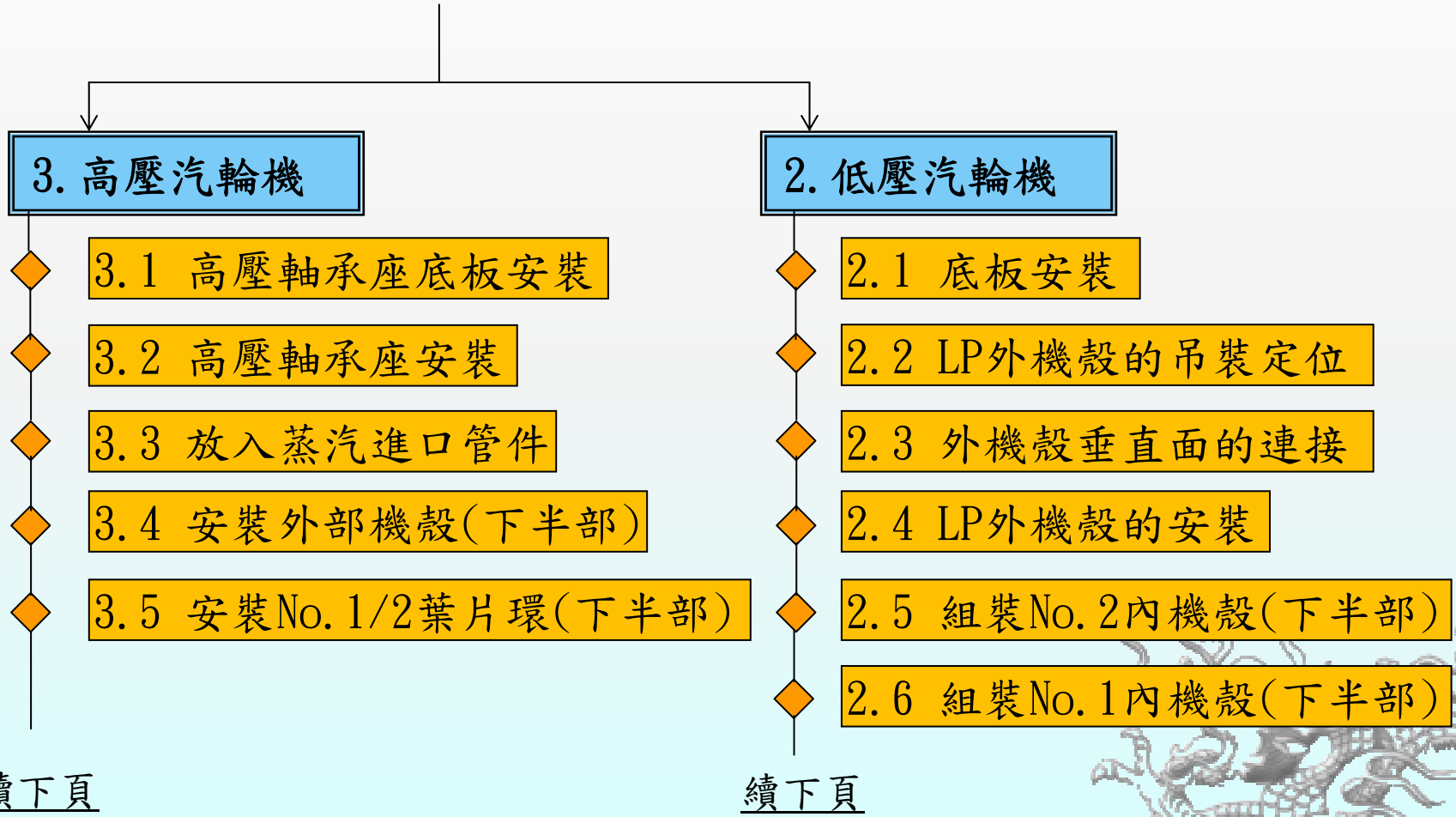
貳、核四廠汽輪發電機安裝步驟



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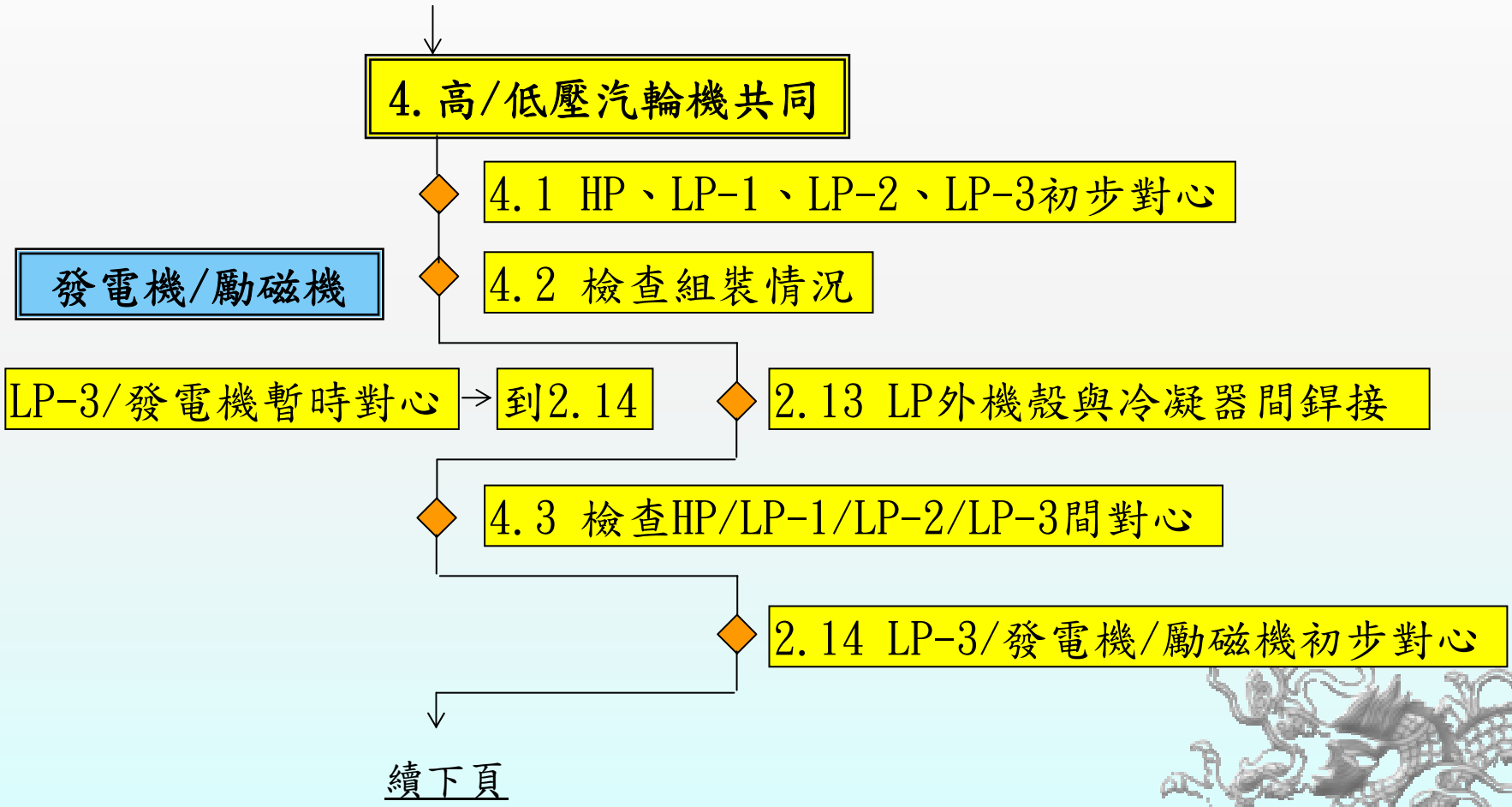
貳、核四廠汽輪發電機安裝步驟

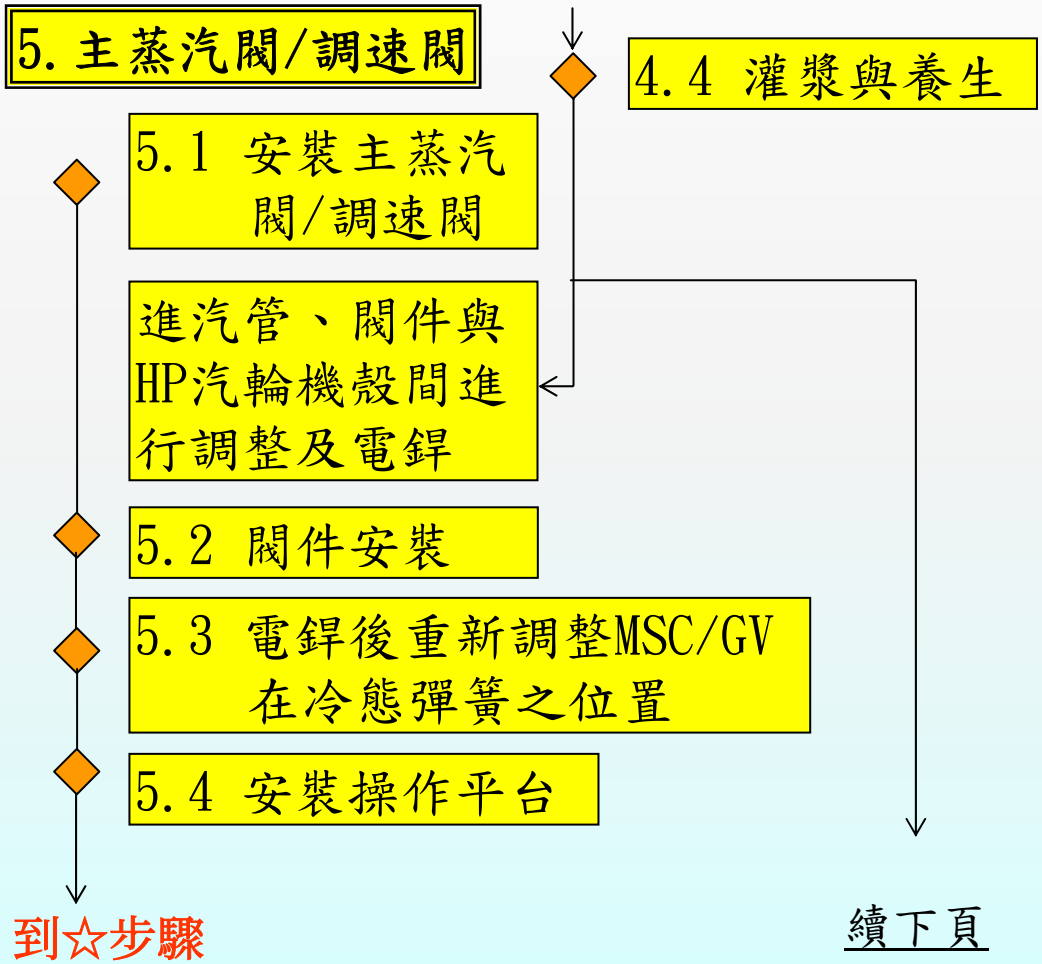
- 2.7 組裝葉片環及蒸汽導流裝置(下半部)
- 2.8 組裝No3~No8軸承(下半部)
- 2.9 安裝LP-1、LP-2、LP-3轉子
- 2.10 設定LP汽輪機轉子
- 2.11 組裝上部格蘭、葉片環、機殼
- 2.12 臨時組裝狀態之檢查
- 3.6 安裝高壓轉子
- 3.7 高壓汽輪機設定
- 3.8 組裝高壓汽輪機(上半部)

續下頁

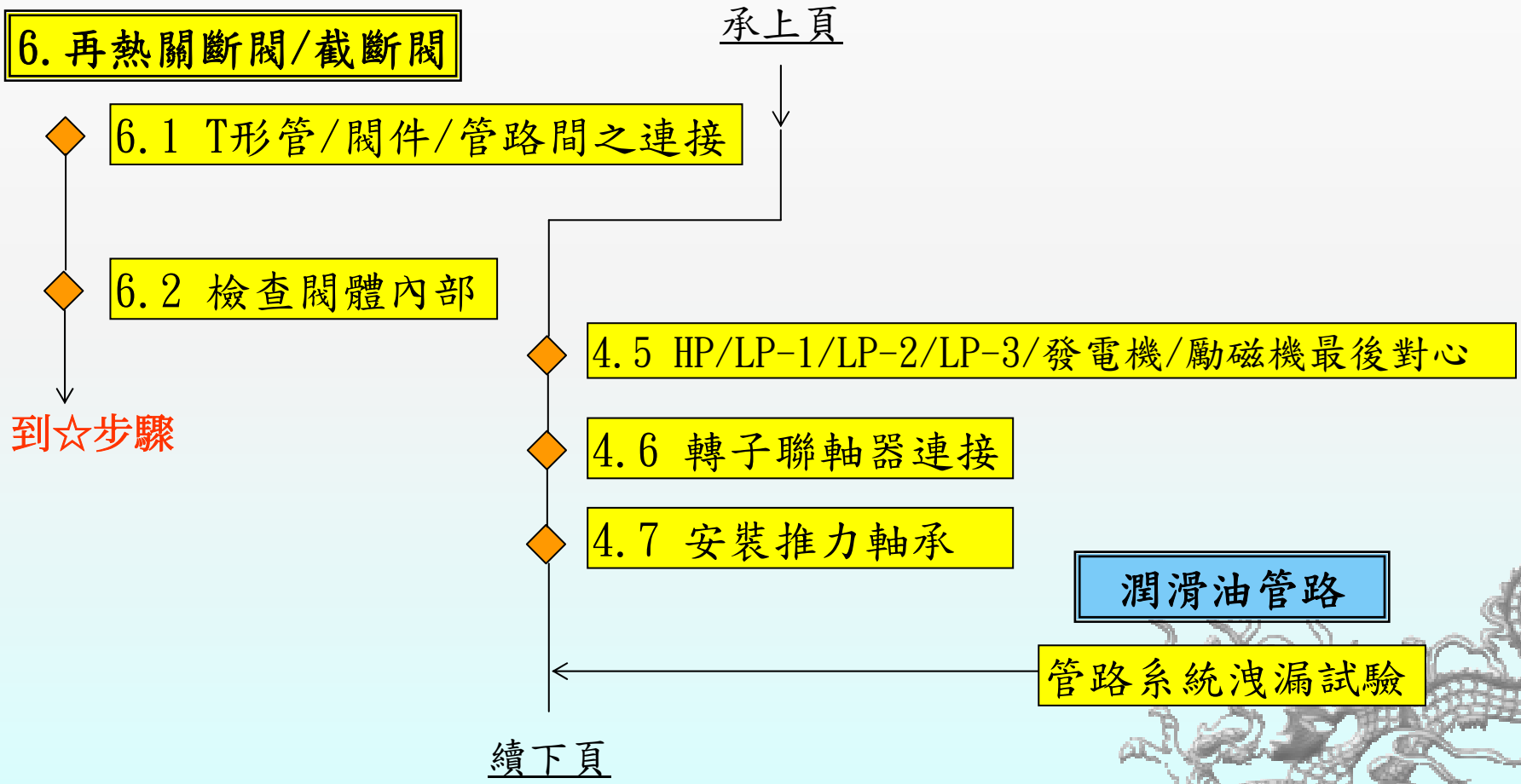
貳、核四廠汽輪發電機安裝步驟



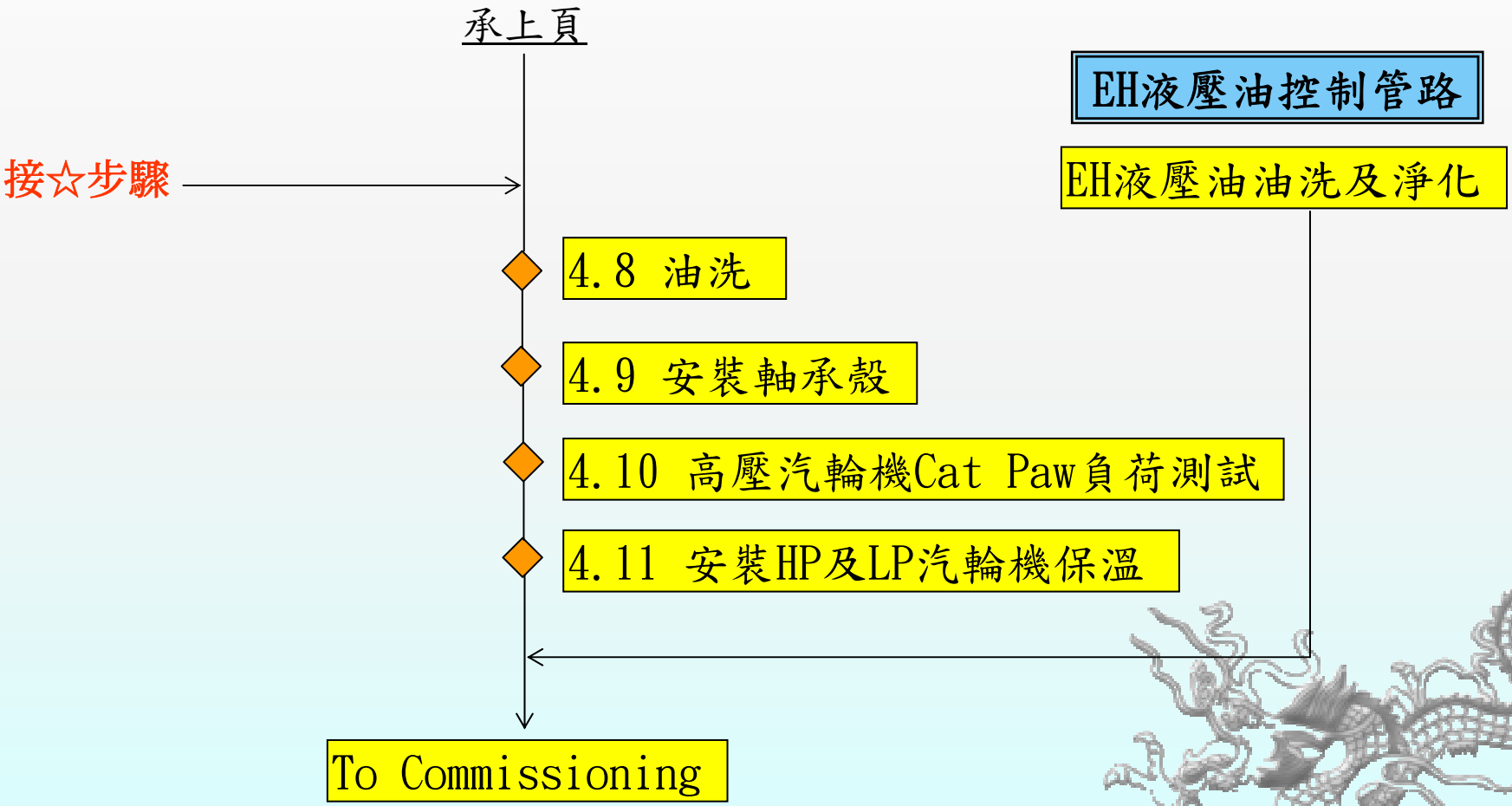
貳、核四廠汽輪發電機安裝步驟



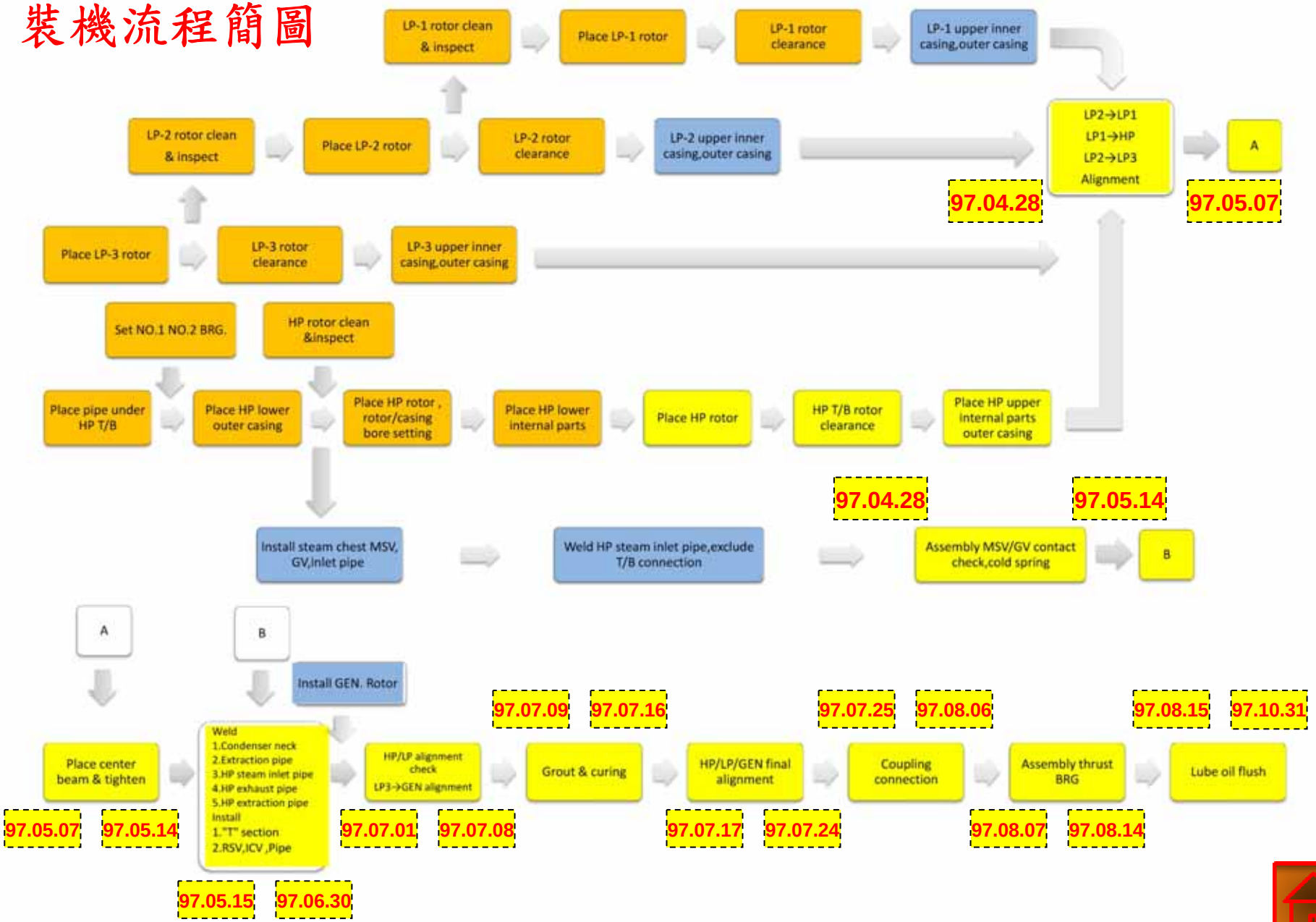
貳、核四廠汽輪發電機安裝步驟



貳、核四廠汽輪發電機安裝步驟



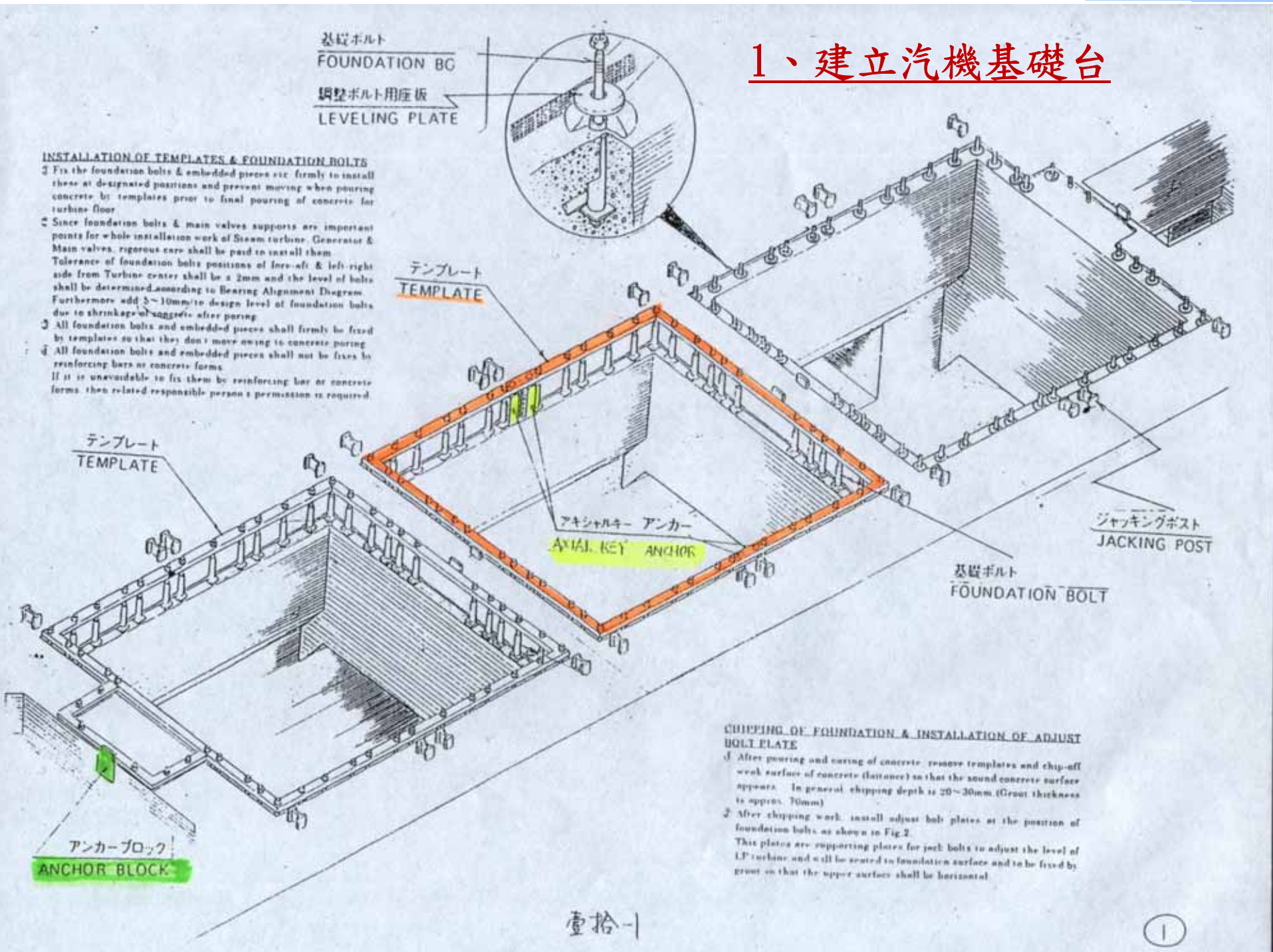
裝機流程簡圖


LP-1 rotor clean & inspect
Place LP-1 rotor
LP-1 rotor clearance
LP-1 upper inner casing,outer casing
LP-2 rotor clean & inspect
Place LP-2 rotor
LP-2 rotor clearance
LP-2 upper inner casing,outer casing
LP2→LP1
LP1→HP
LP2→LP3
Alignment
A
97.04.28
97.05.07
Place LP-3 rotor
LP-3 rotor clearance
LP-3 upper inner casing,outer casing
Set NO.1 NO.2 BRG.
HP rotor clean &inspect
Place pipe under HP T/B
Place HP lower outer casing
Place HP rotor , rotor/casing bore setting
Place HP lower internal parts
Place HP rotor
HP T/B rotor clearance
Place HP upper internal parts outer casing
97.04.28
97.05.14
Install steam chest MSV, GV,inlet pipe
Weld HP steam inlet pipe,exclude T/B connection
Assembly MSV/GV contact check,cold spring
B
A
B
Install GEN. Rotor
97.07.09
97.07.16
97.07.25
97.08.06
97.08.15
97.10.31
Place center beam & tighten
Weld
1.Condenser neck
2.Extraction pipe
3.HP steam inlet pipe
4.HP exhaust pipe
5.HP extraction pipe
Install
1."T" section
2.RSV,ICV ,Pipe
HP/LP alignment check
LP3→GEN alignment
Grout & curing
HP/LP/GEN final alignment
Coupling connection
Assembly thrust BRG
Lube oil flush
97.05.07
97.05.14
97.07.01
97.07.08
97.07.17
97.07.24
97.08.07
97.08.14
97.05.15
97.06.30

貳、核四廠汽輪發電機安裝步驟

- 汽機裝機示意圖如次頁

1、建立汽機基礎台



INSTALLATION OF TEMPLATES & FOUNDATION BOLTS

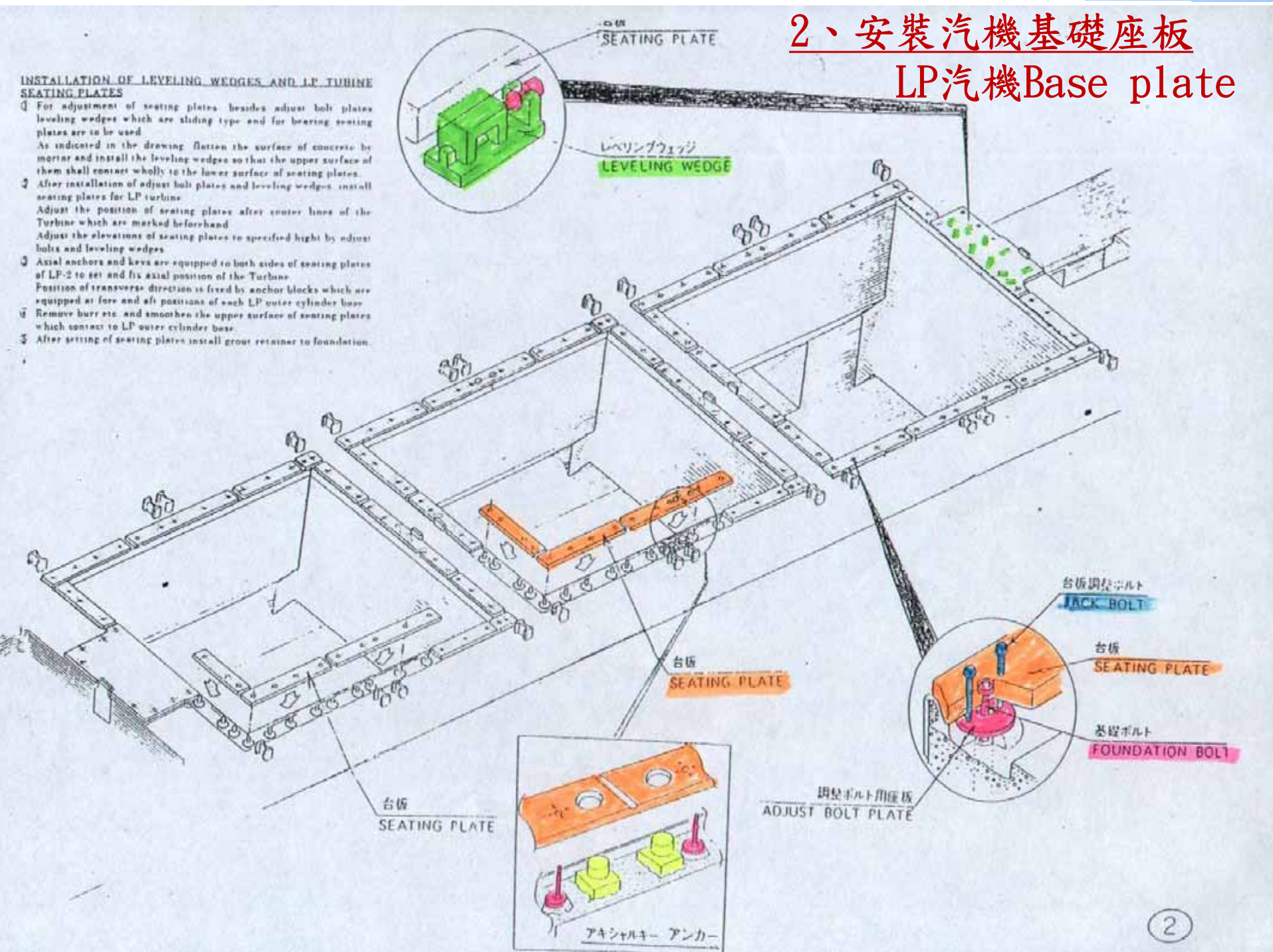
1. Fix the foundation bolts & embedded pieces etc firmly to install these at designated positions and prevent moving when pouring concrete by templates prior to final pouring of concrete for turbine floor
2. Since foundation bolts & main valves supports are important points for whole installation work of Steam turbine, Generator & Main valves, rigorous care shall be paid to install them. Tolerance of foundation bolts positions of fore-aft & left-right side from Turbine center shall be ± 2mm and the level of bolts shall be determined according to Bearing Alignment Diagram. Furthermore add 5~10mm to design level of foundation bolts due to shrinkage of concrete after poring.
3. All foundation bolts and embedded pieces shall firmly be fixed by templates so that they don't move owing to concrete poring.
4. All foundation bolts and embedded pieces shall not be fixes to reinforcing bars or concrete forms.
   If it is unavoidable to fix them by reinforcing bar or concrete forms, then related responsible person's permission is required.

CHIPPING OF FOUNDATION & INSTALLATION OF ADJUST BOLT PLATE

1. After pouring and curing of concrete, remove templates and chip-off weak surface of concrete (laitance) so that the sound concrete surface appears. In general, chipping depth is 20~30mm. (Grout thickness is approx. 70mm)
2. After chipping work, install adjust bolt plates at the position of foundation bolts as shown in Fig.2.
   This plates are supporting plates for jack bolts to adjust the level of LP turbine and will be seated to foundation surface and to be fixed by grout so that the upper surface shall be horizontal.

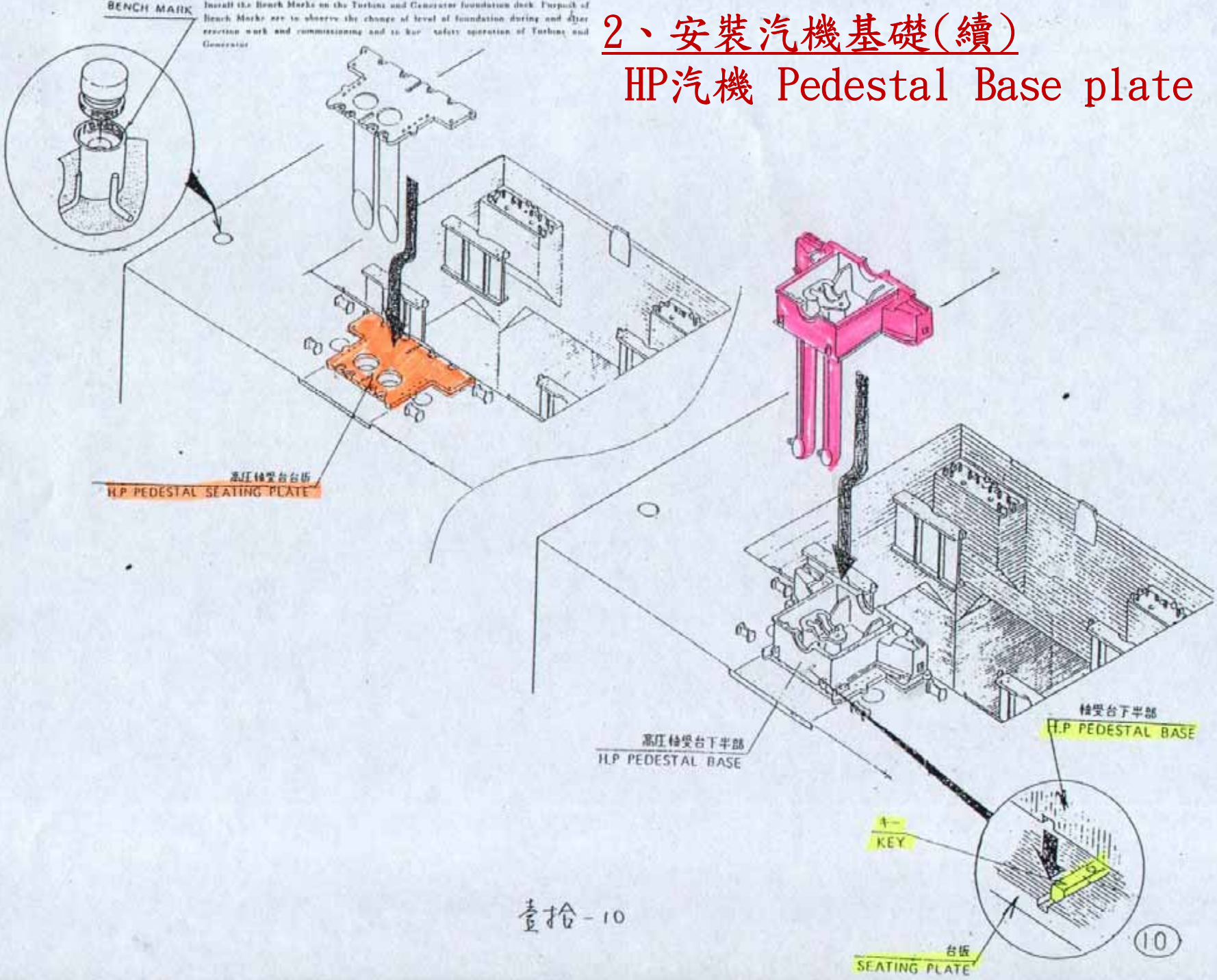

2006.06.08

2、安裝汽機基礎座板
LP汽機Base plate



2、安裝汽機基礎(續)

HP汽機 Pedestal Base plate

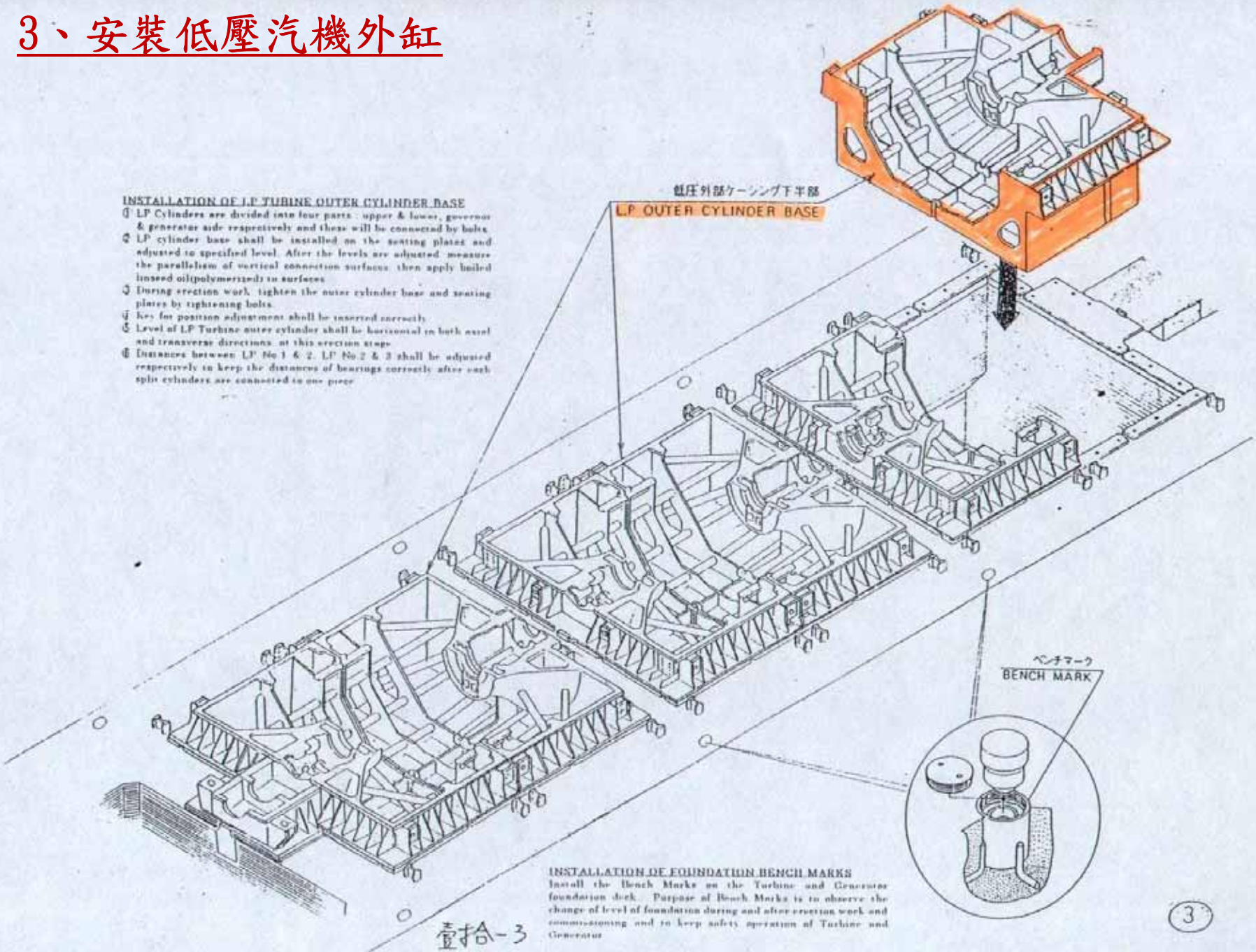


(10)

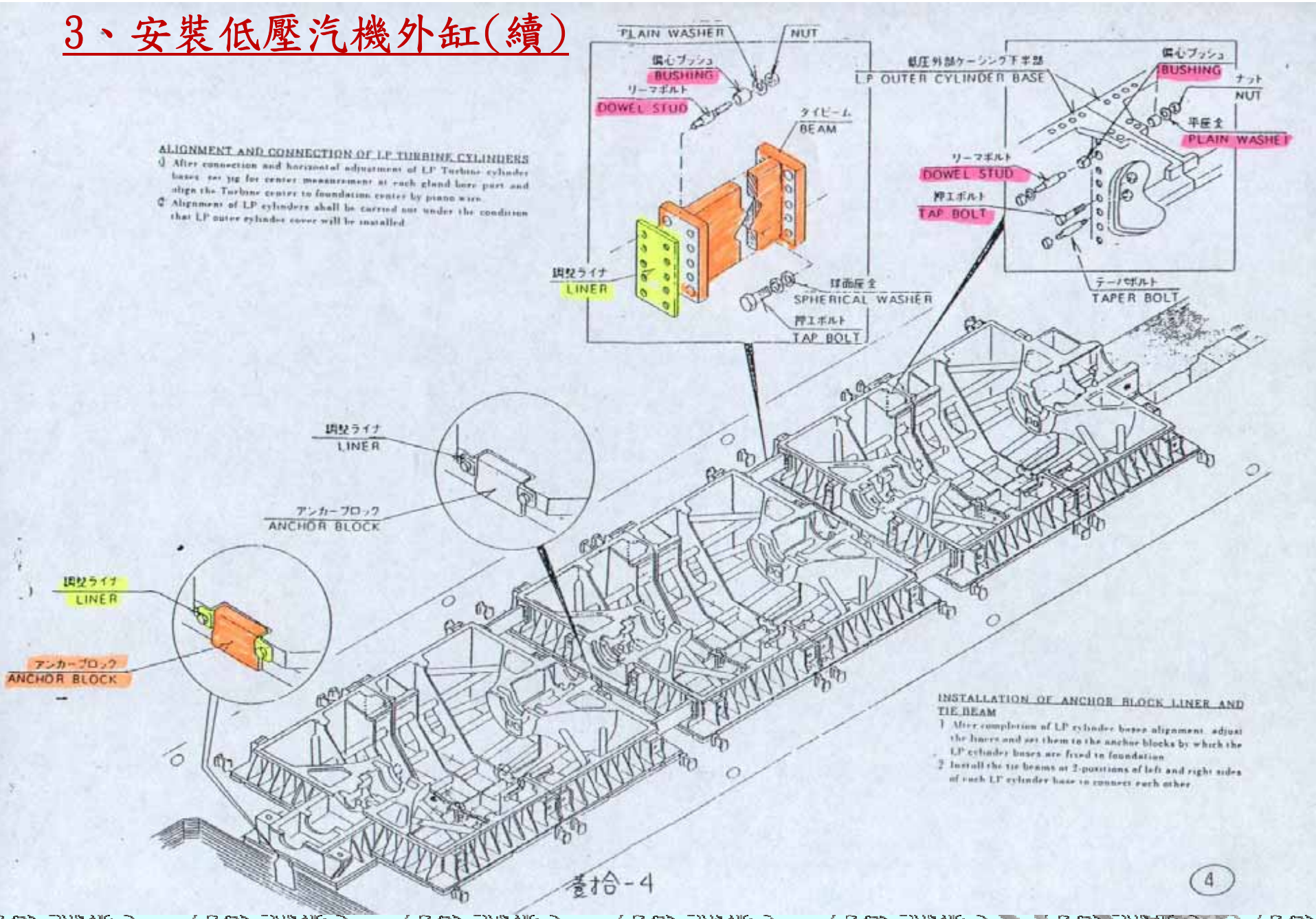

2007/08/07


2007/10/09

3、安裝低壓汽機外缸


INSTALLATION OF LP TURBINE OUTER CYLINDER BASE
① LP Cylinders are divided into four parts : upper & lower, governor & generator side respectively and these will be connected by bolts.
② LP cylinder base shall be installed on the seating plates and adjusted to specified level. After the levels are adjusted, measure the parallelism of vertical connection surfaces, then apply boiled linseed oil(polymerized) to surfaces.
③ During erection work, tighten the outer cylinder base and seating plates by tightening bolts.
④ Key for position adjustment shall be inserted correctly.
⑤ Level of LP Turbine outer cylinder shall be horizontal in both axial and transverse directions, at this erection stage.
⑥ Distances between LP No 1 & 2, LP No 2 & 3 shall be adjusted respectively to keep the distances of bearings correctly after each split cylinders are connected to one piece.
低圧外部ケーシング下半部
L.P OUTER CYLINDER BASE
ベンチマーク
BENCH MARK
INSTALLATION OF FOUNDATION BENCH MARKS
Install the Bench Marks on the Turbine and Generator foundation deck. Purpose of Bench Marks is to observe the change of level of foundation during and after erection work and commissioning and to keep safety operation of Turbine and Generator.
壹拾-3
3

3、安裝低壓汽機外缸(續)



ALIGNMENT AND CONNECTION OF LP TURBINE CYLINDERS

① After connection and horizontal adjustment of LP Turbine cylinder bases, use jig for center measurement at each gland bore part and align the Turbine center to foundation center by piano wire.

② Alignment of LP cylinders shall be carried out under the condition that LP outer cylinder cover will be installed.

INSTALLATION OF ANCHOR BLOCK LINER AND TIE BEAM

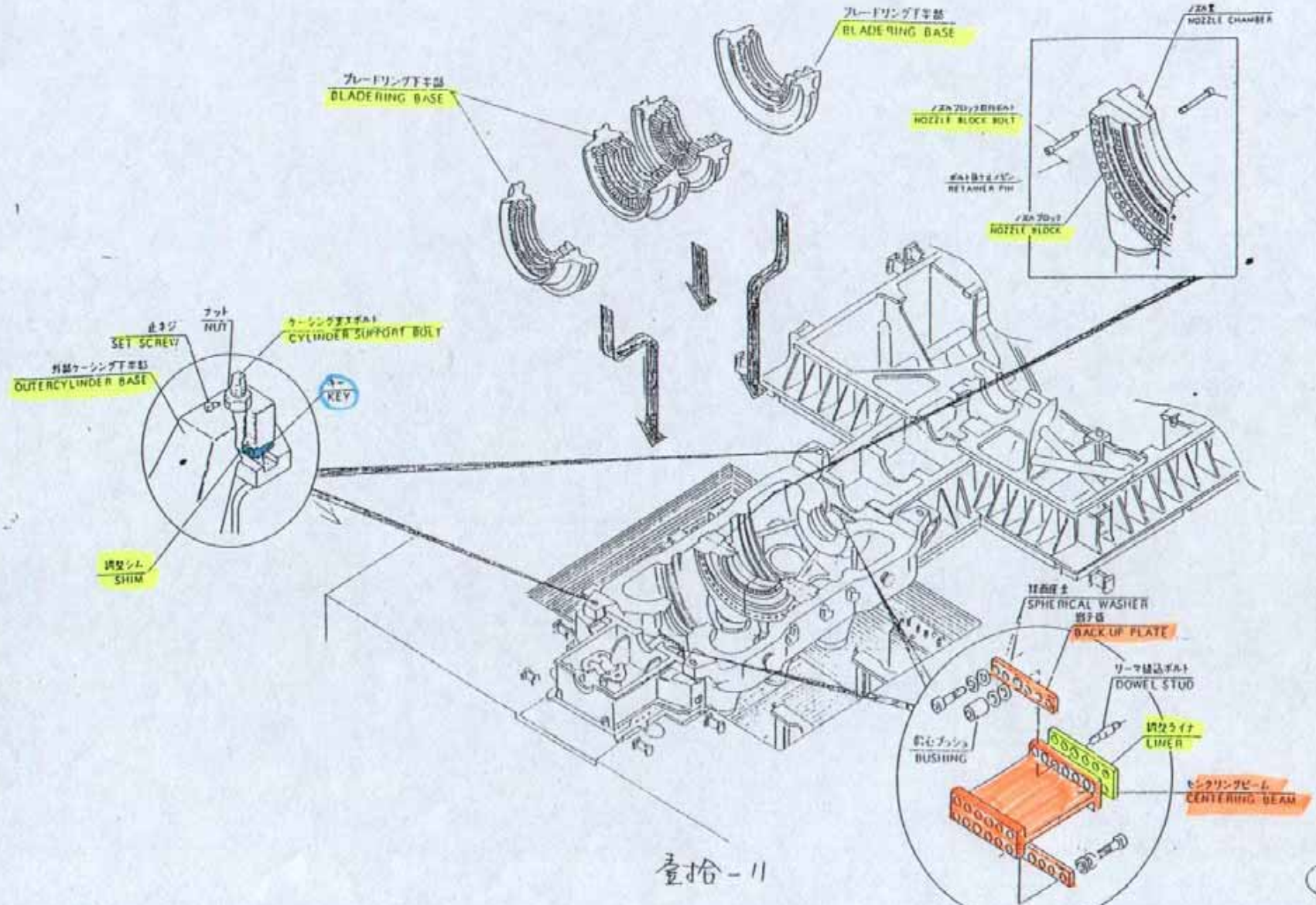
1 After completion of LP cylinder bases alignment, adjust the liners and set them to the anchor blocks by which the LP cylinder bases are fixed to foundation.

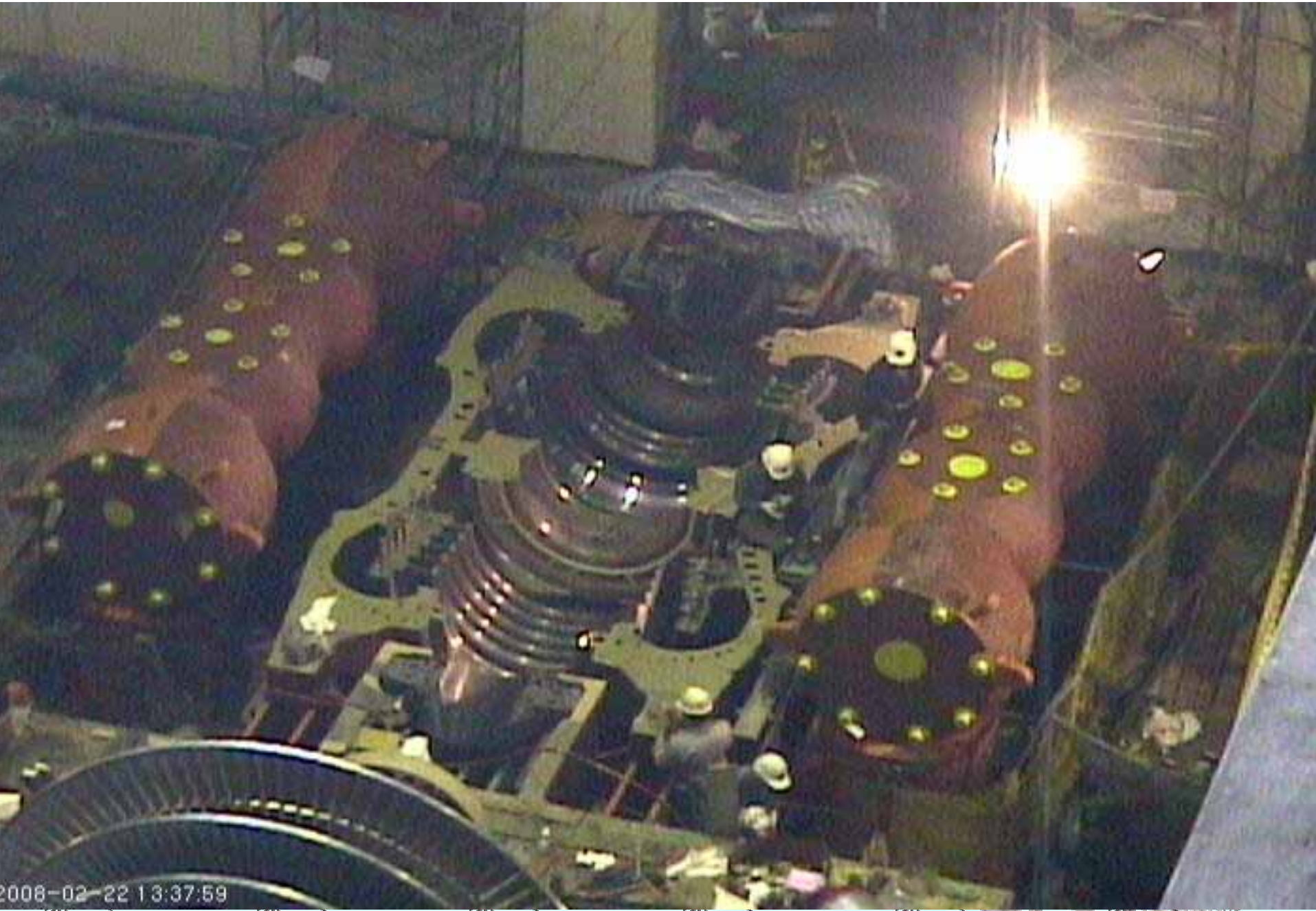
2 Install the tie beams at 2-positions of left and right sides of each LP cylinder base to connect each other.

壹拾-4

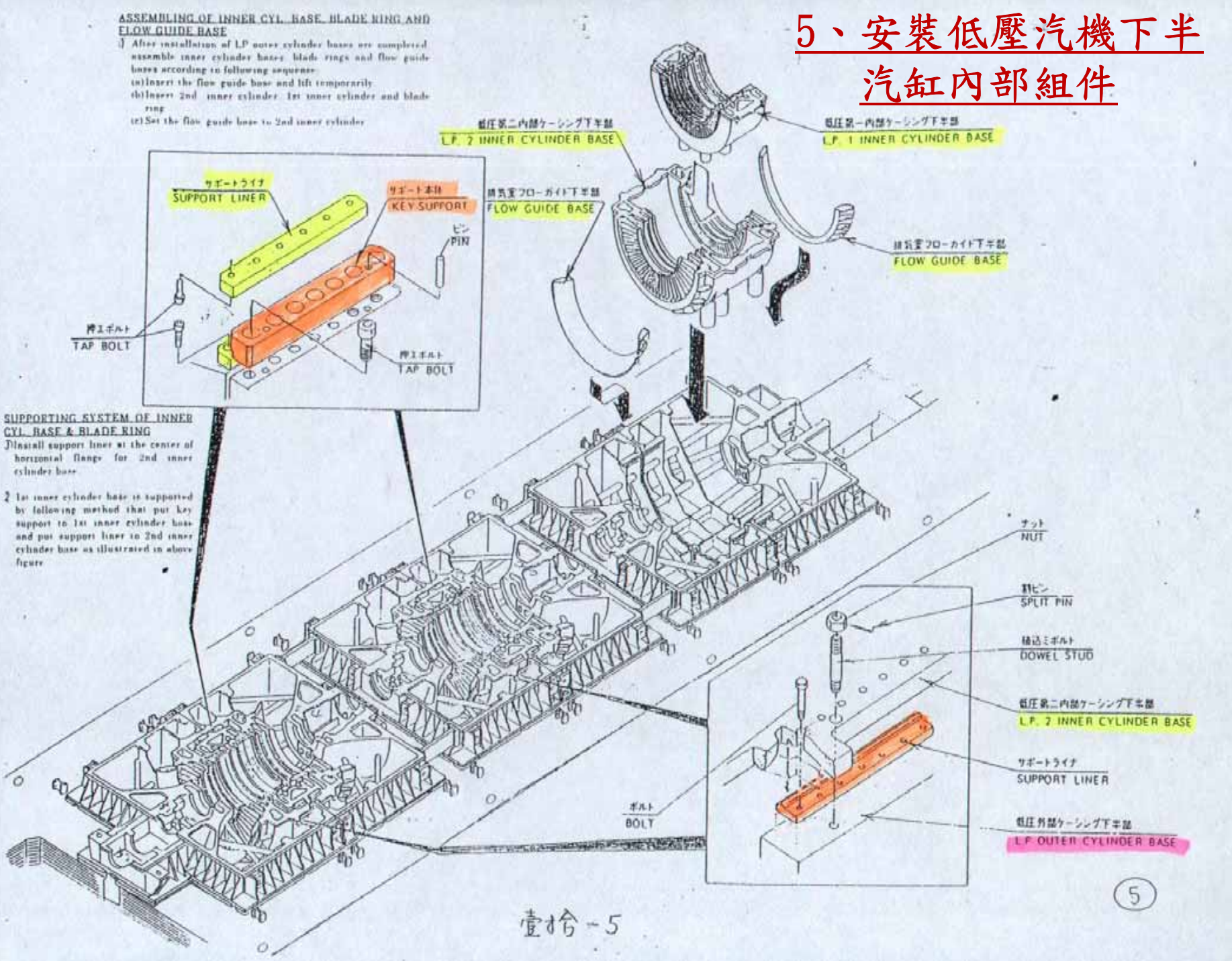

2007/07/12

4、安裝高壓汽機外缸基座
(HP Cylinder Base)




2008-02-22 13:37:59

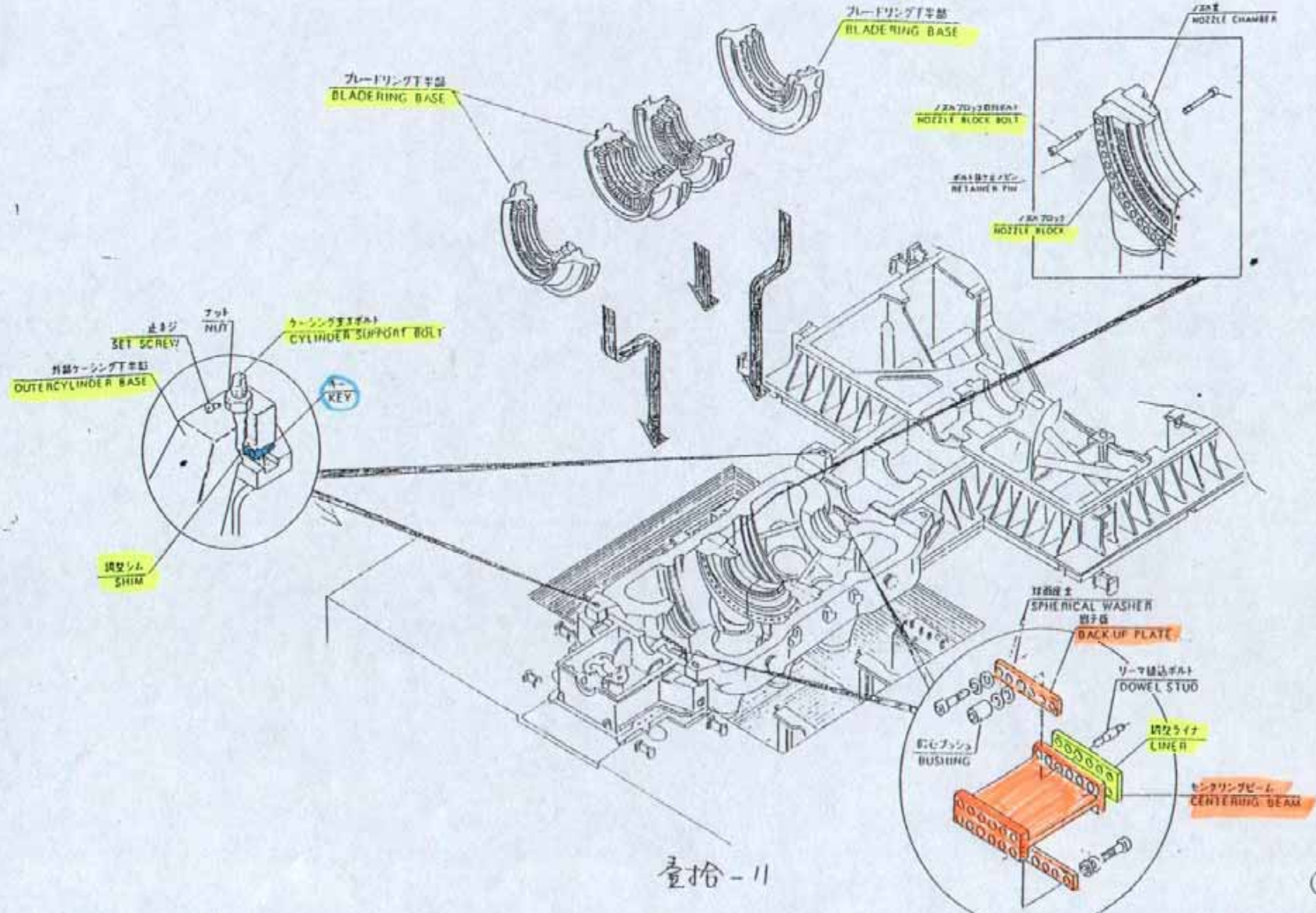
5、安裝低壓汽機下半汽缸內部組件



壹拾-5


2007/11/06

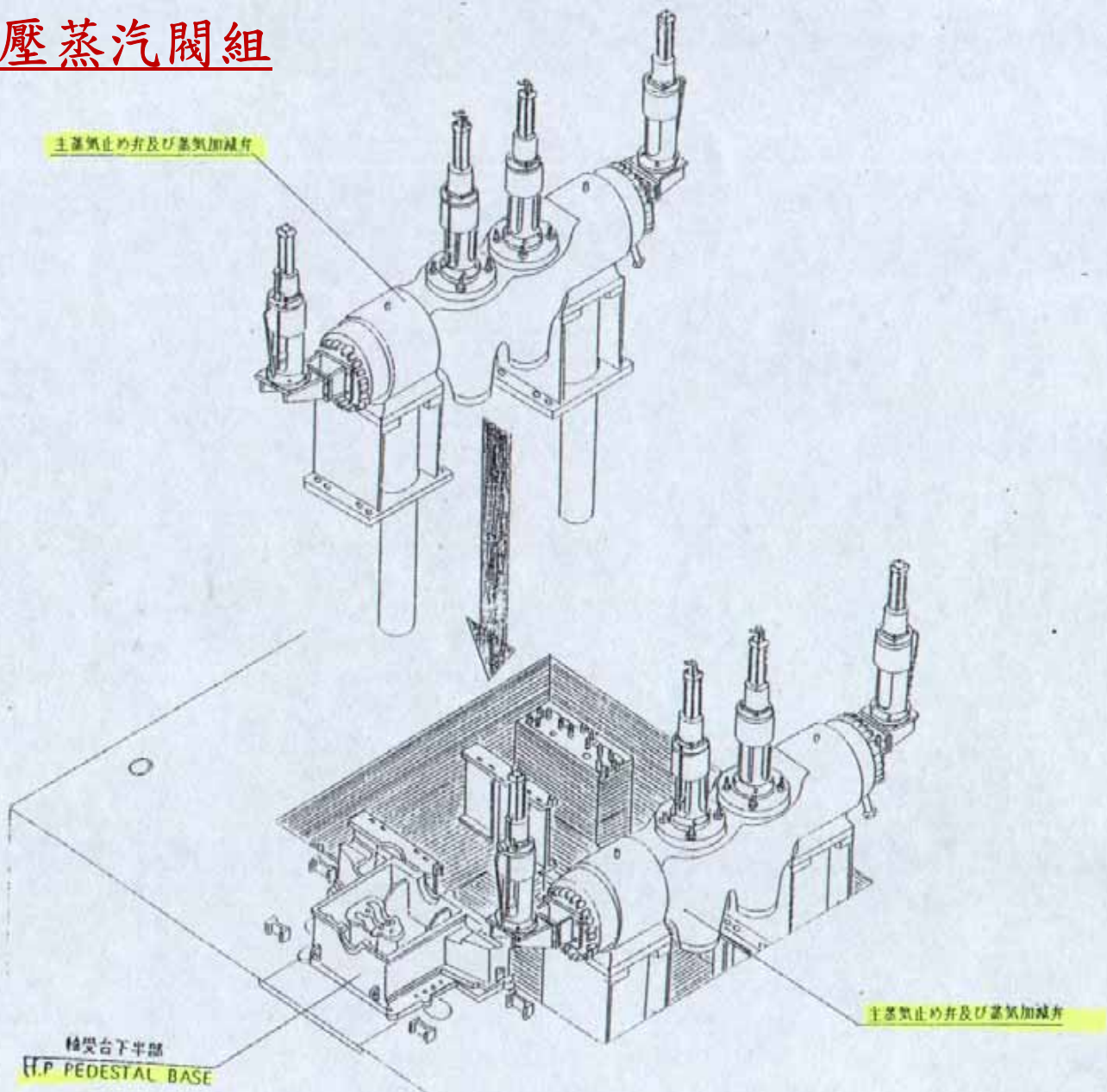
6、安裝高壓汽機下半汽缸內部組件



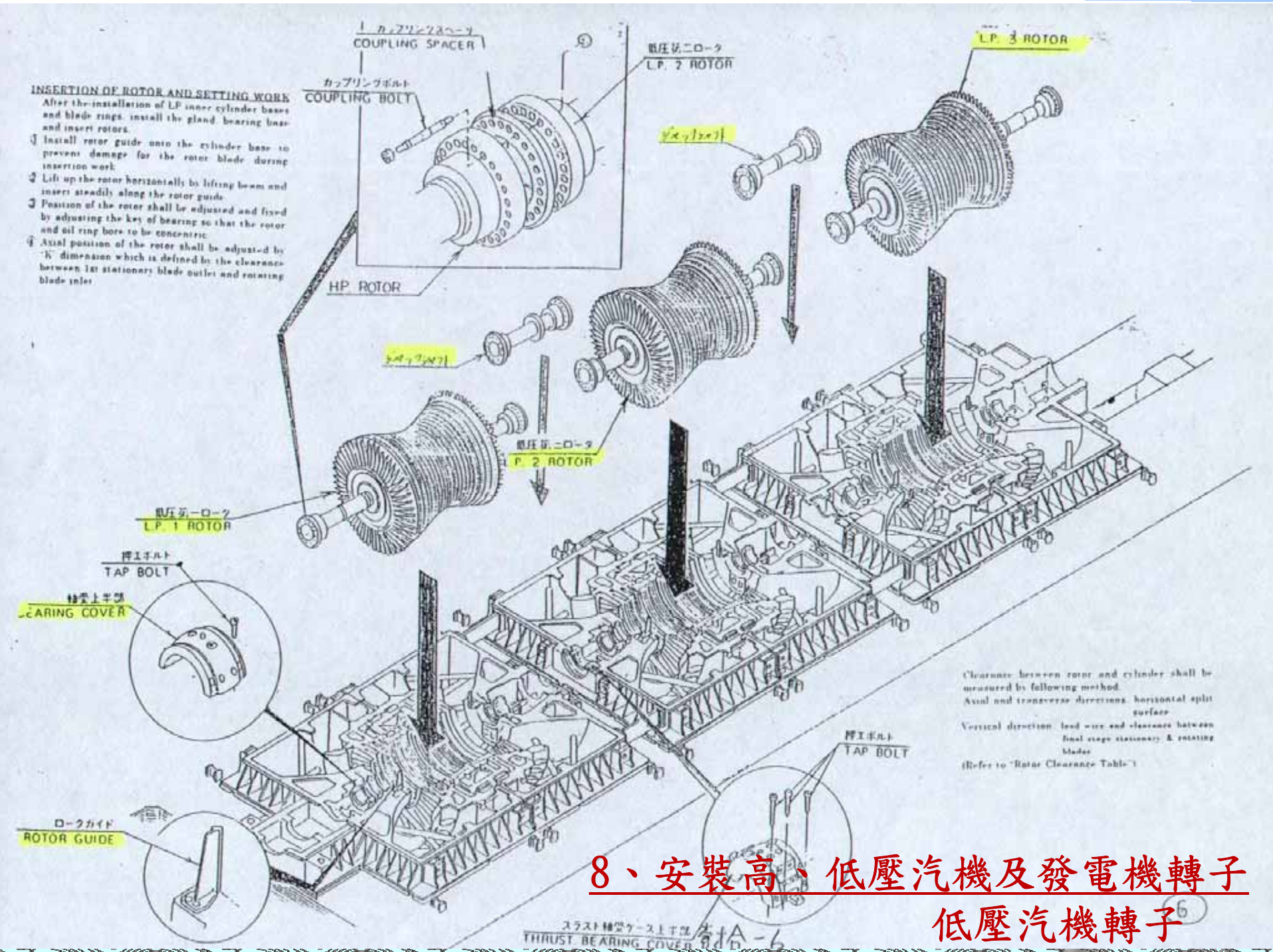
重指-11


2008/02/22

7、安裝高壓蒸汽閥組




2008/01/24



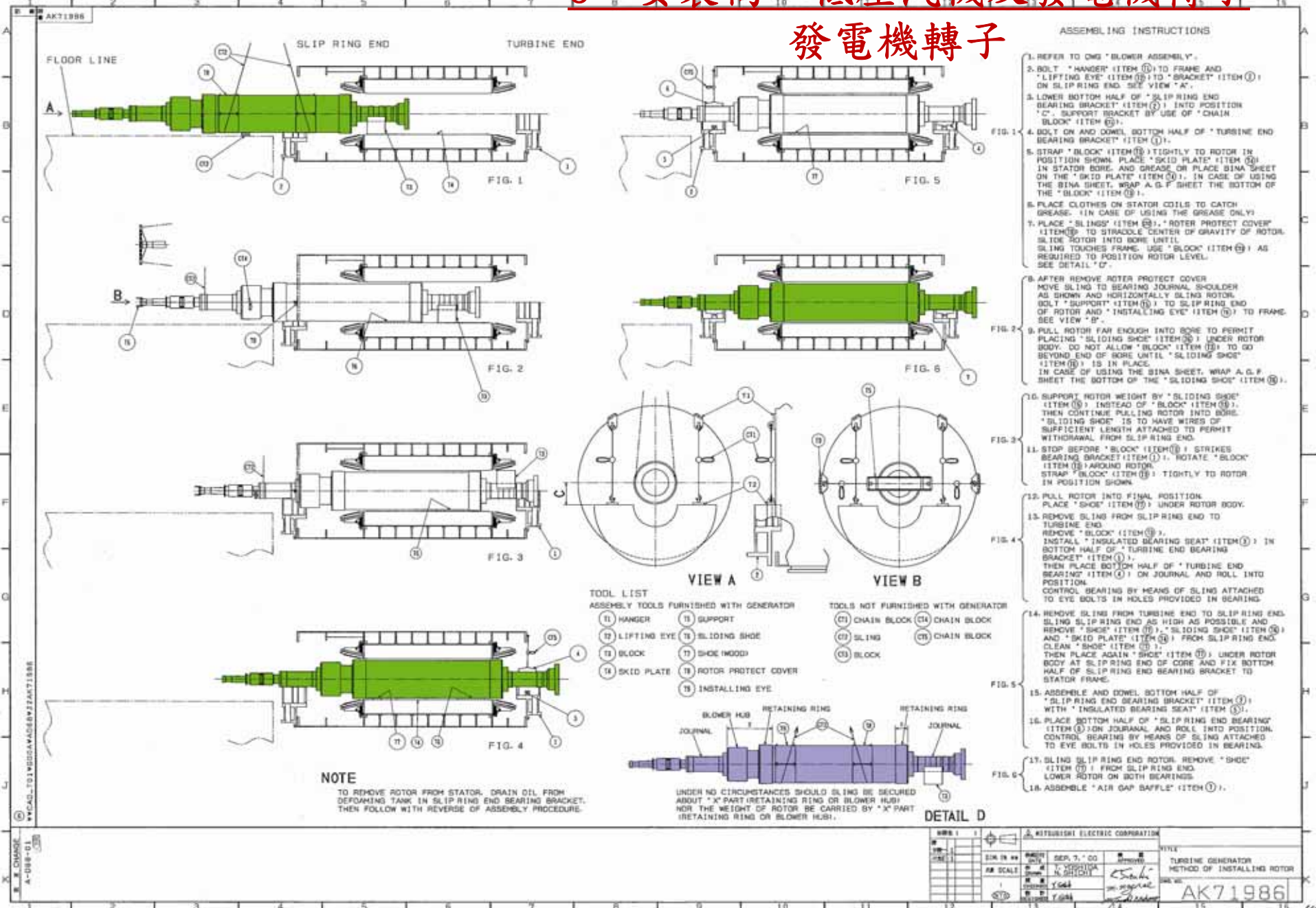
8、安裝高、低壓汽機及發電機轉子

低壓汽機轉子


2007/11/15

8、安裝高、低壓汽機及發電機轉子

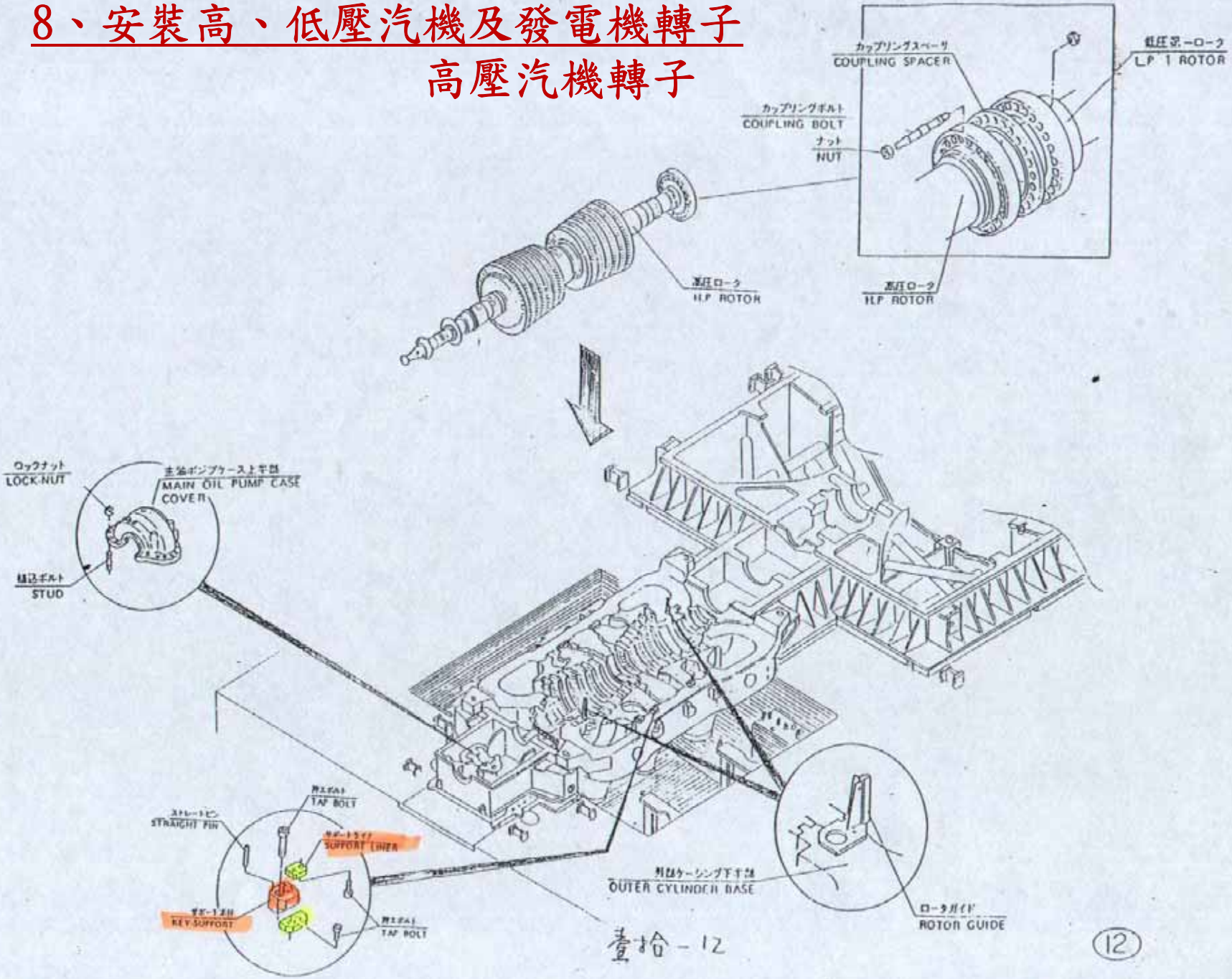
發電機轉子




2008/01/17

8、安裝高、低壓汽機及發電機轉子

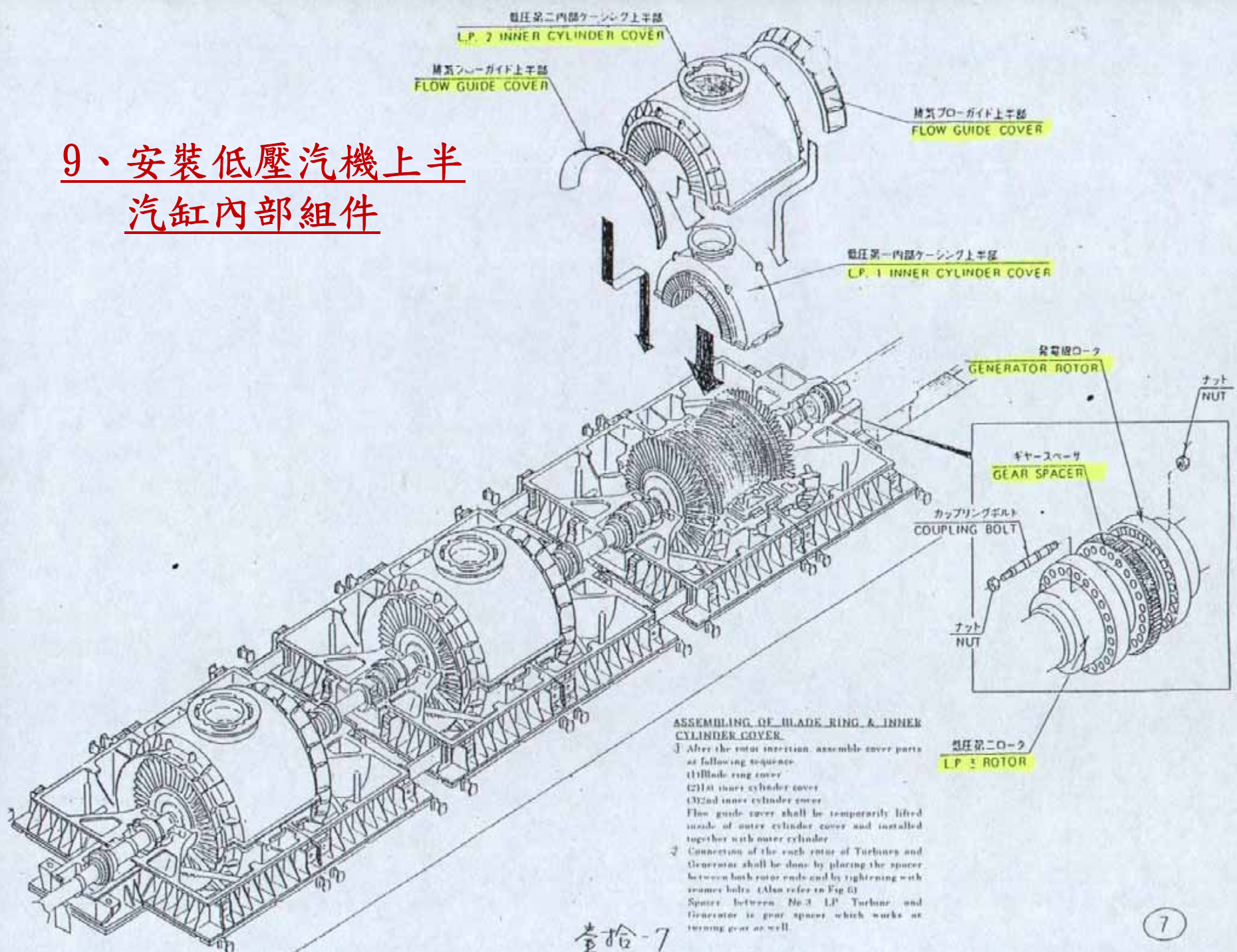
高壓汽機轉子



叁拾－12


2008/01/28

9、安裝低壓汽機上半汽缸內部組件



ASSEMBLING OF BLADE RING & INNER CYLINDER COVER

1 After the rotor insertion, assemble cover parts as following sequence

(1)Blade ring cover

(2)1st inner cylinder cover

(3)2nd inner cylinder cover

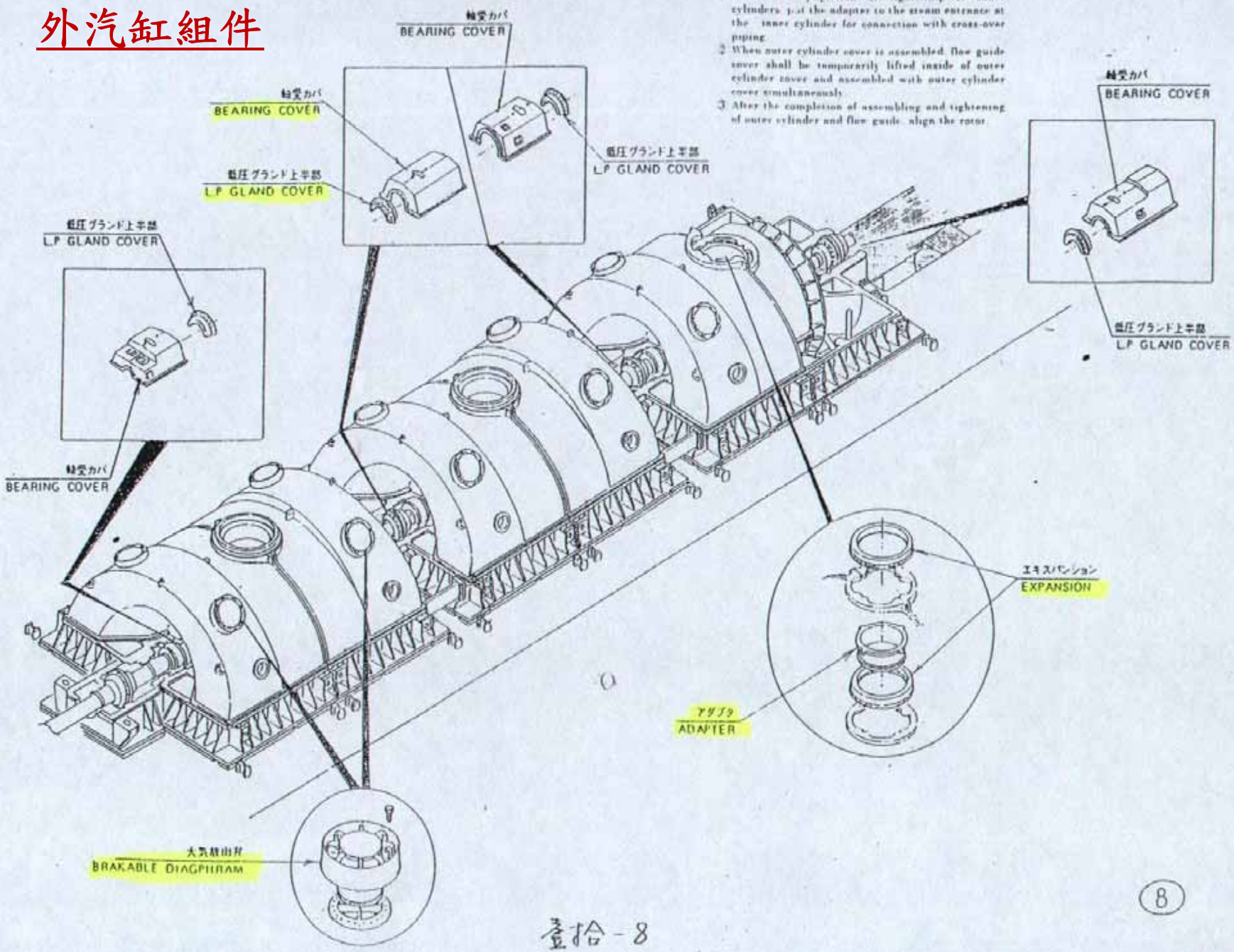
Flow guide cover shall be temporarily lifted inside of outer cylinder cover and installed together with outer cylinder.

2 Connection of the each rotor of Turbines and Generator shall be done by placing the spacer between both rotor ends and by tightening with reamer bolts. (Also refer to Fig 6)

Spacer between No.3 LP Turbine and Generator is gear spacer which works as turning gear as well.


2008/02/09

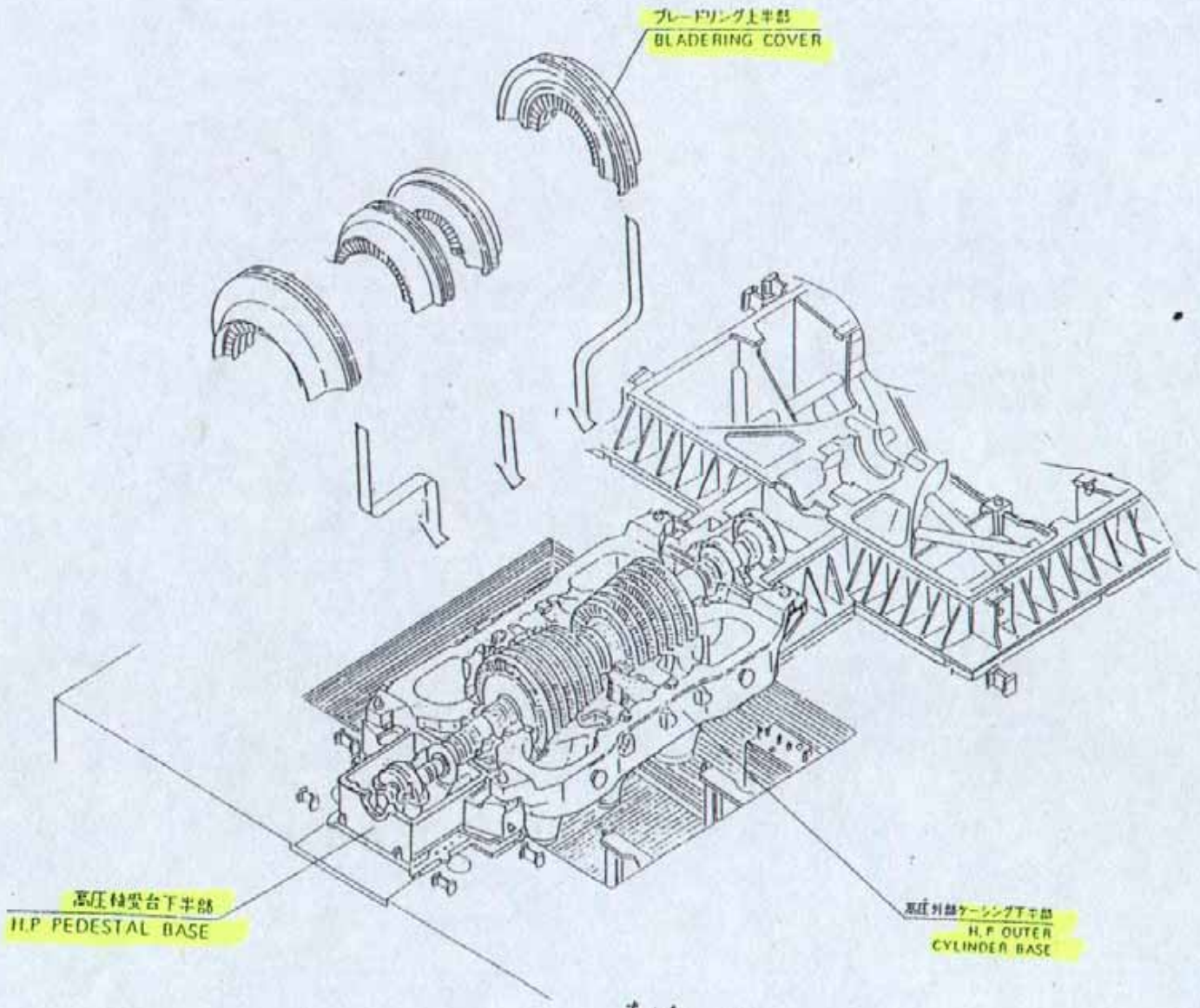
10、安裝低壓汽機上半外汽缸組件




2008/04/02

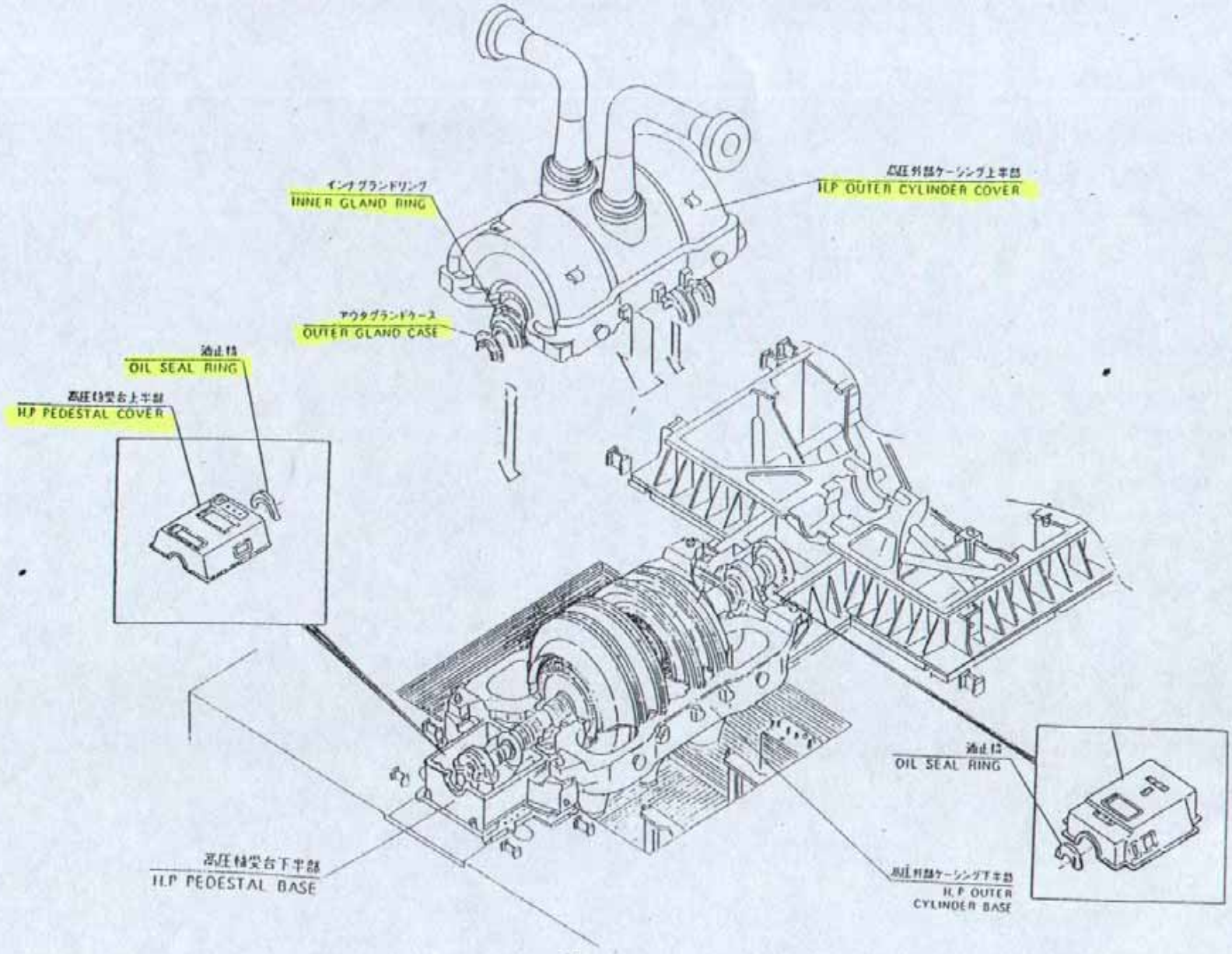

2008/04/02

11、安裝高壓汽機上半汽缸組件



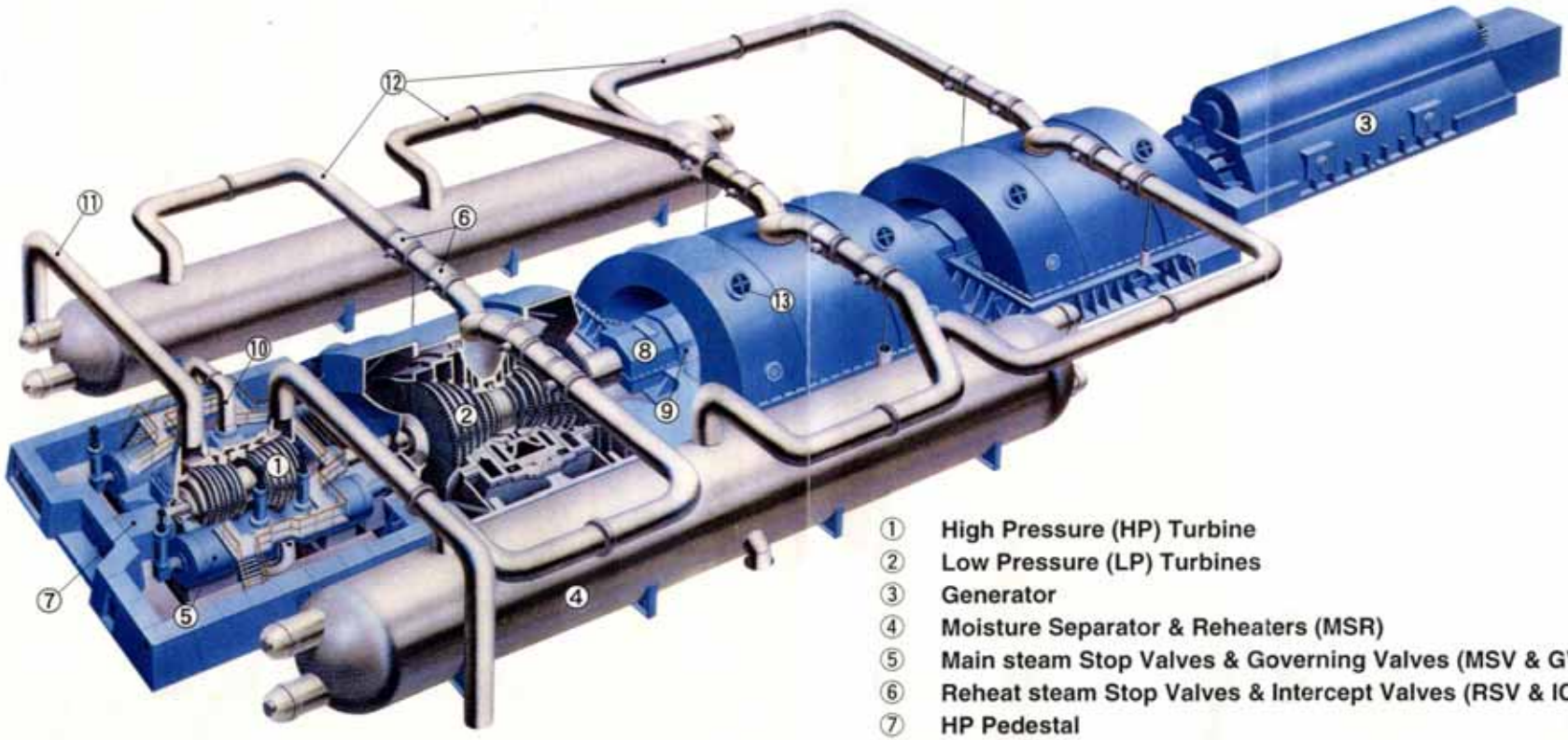
壹拾-13

11、安裝高壓汽機上半汽缸組件(續)



壹拾-14

Mitsubishi Nuclear Steam Turbine



① High Pressure (HP) Turbine
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⑬ Rupture Discs

Final Erection

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