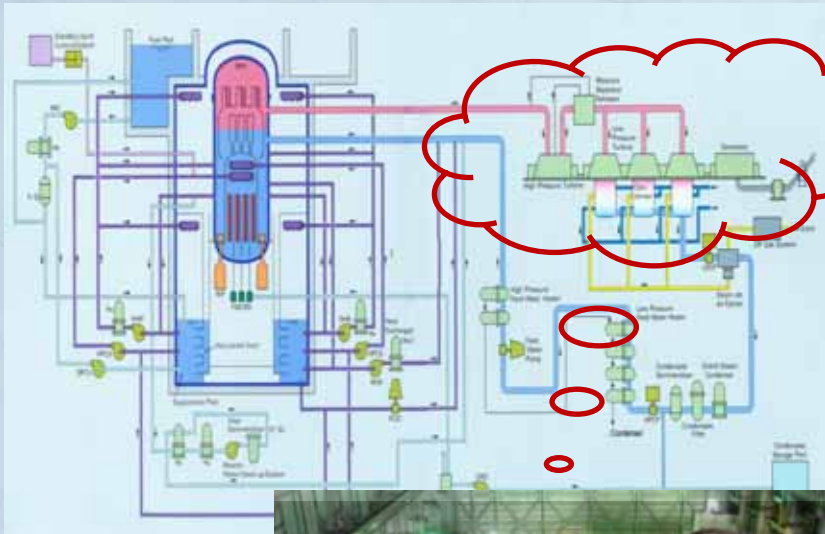


核能四廠安全監督委員會第2屆第8次會議

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

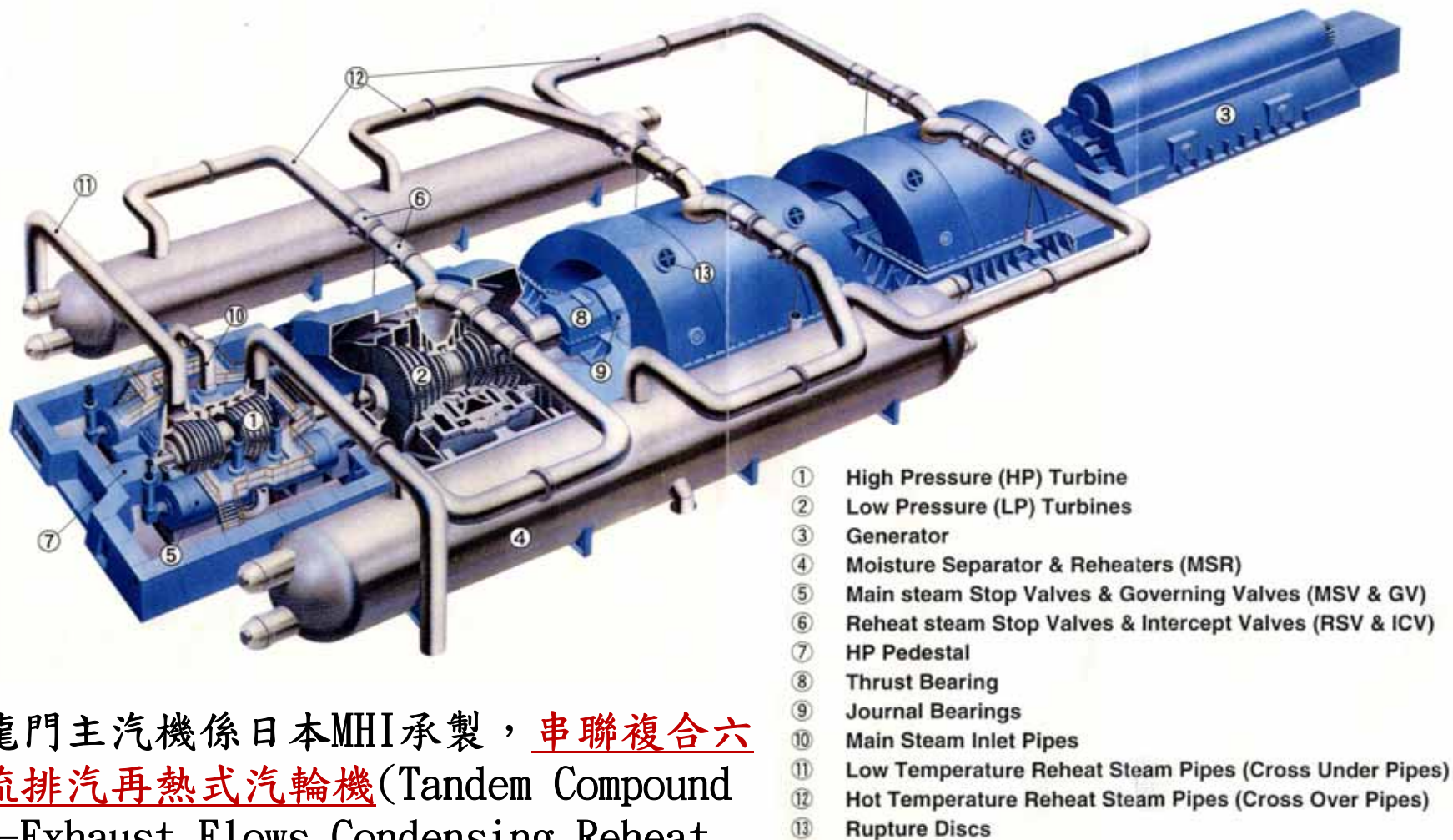
敬請指教



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

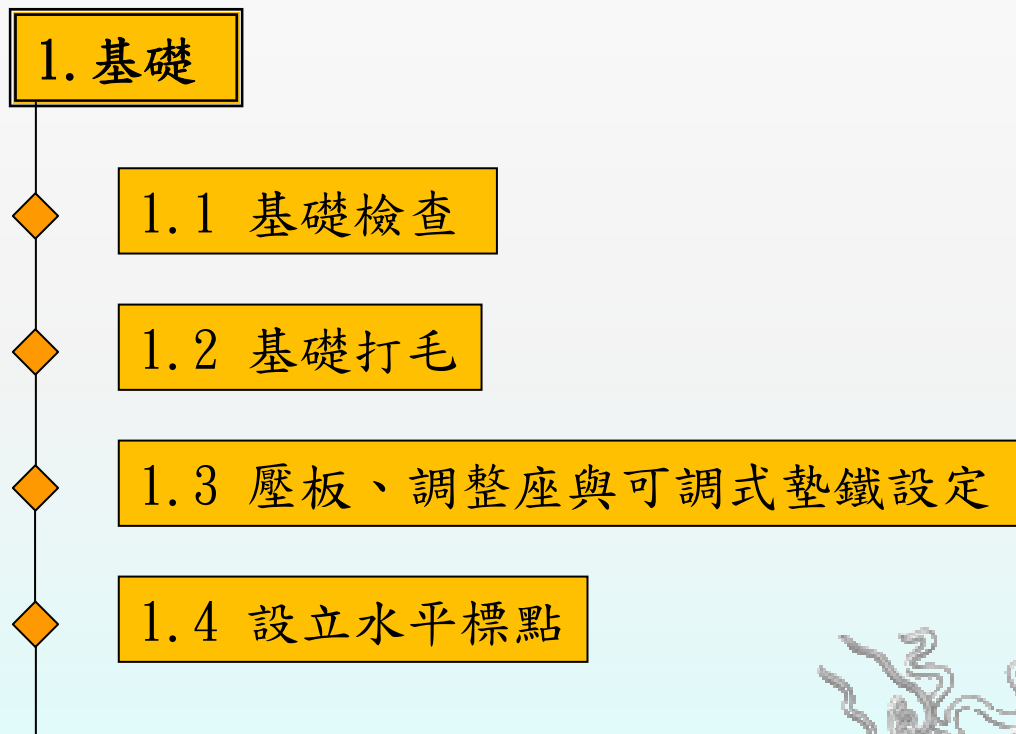


龍門主汽機係日本MHI承製，串聯複合六
流排汽再熱式汽輪機(Tandem Compound
6-Exhaust Flows Condensing Reheat
Turbine；一高壓、三低壓)，位在汽機
廠房頂樓 EL 30500mm

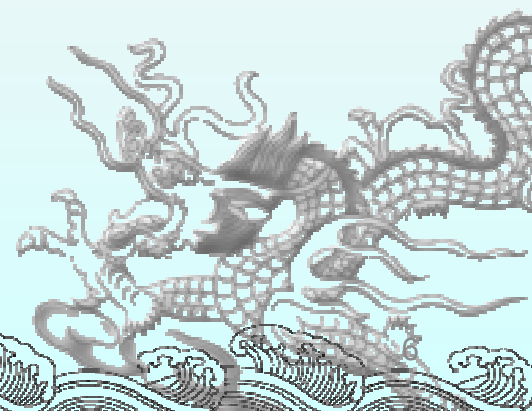


貳、核四廠汽輪發電機安裝步驟

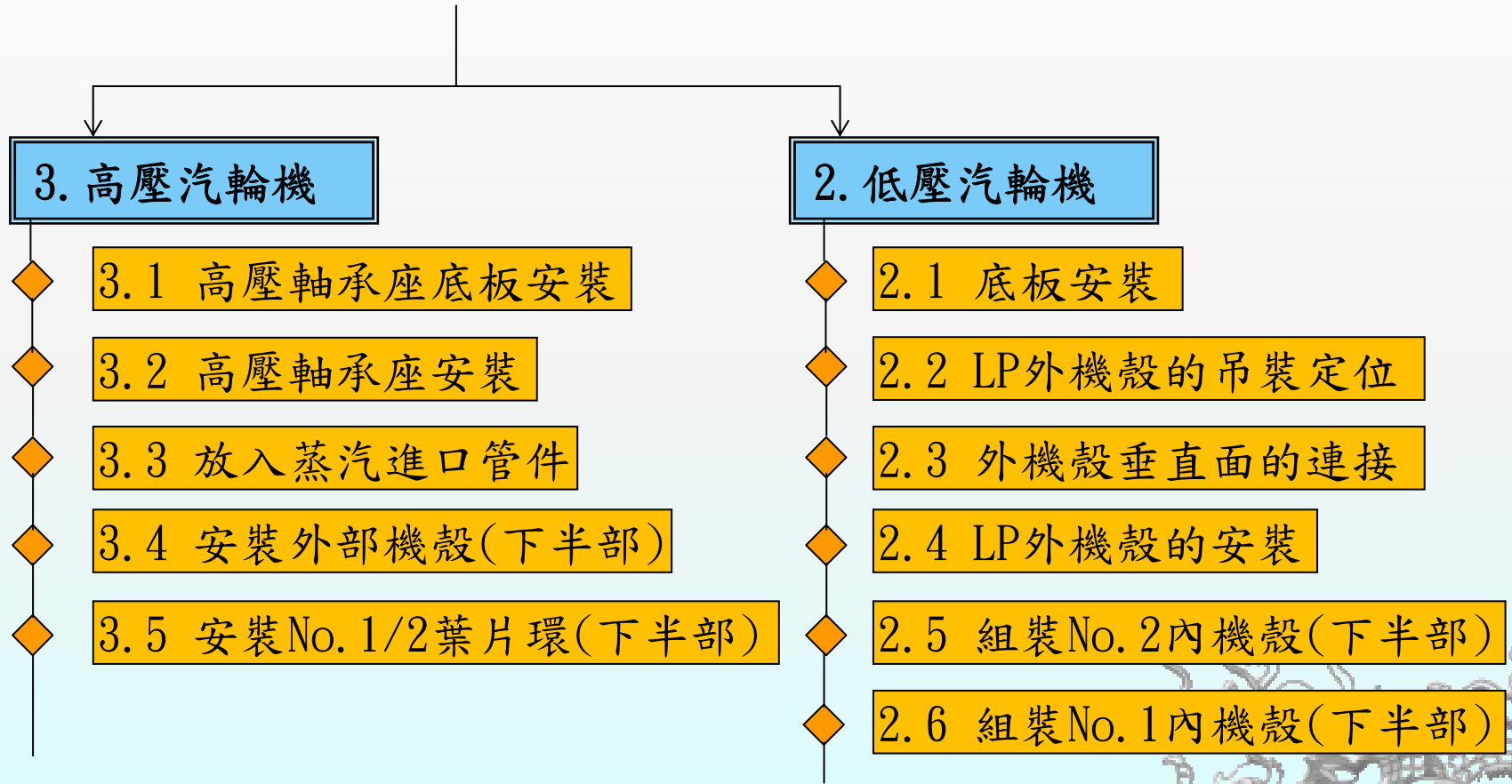
二、安裝流程圖



續下頁



貳、核四廠汽輪發電機安裝步驟



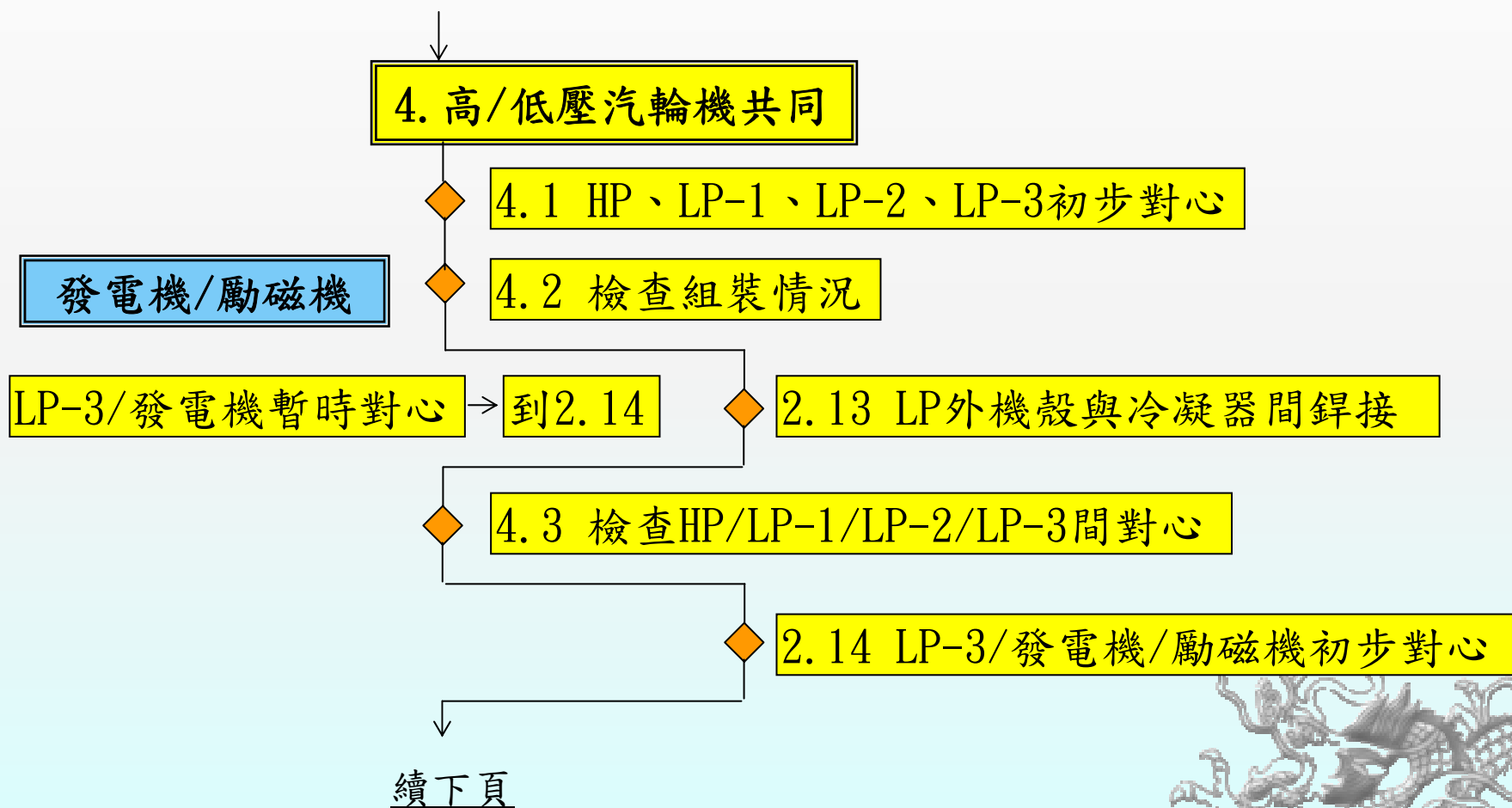
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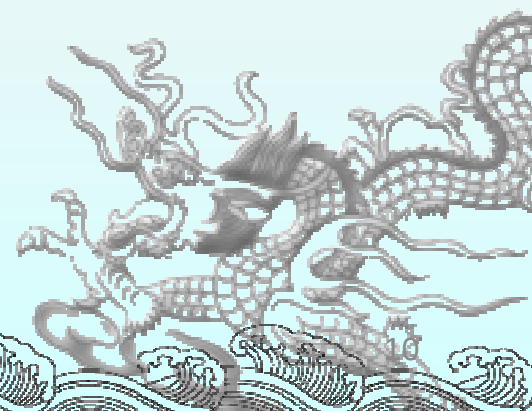
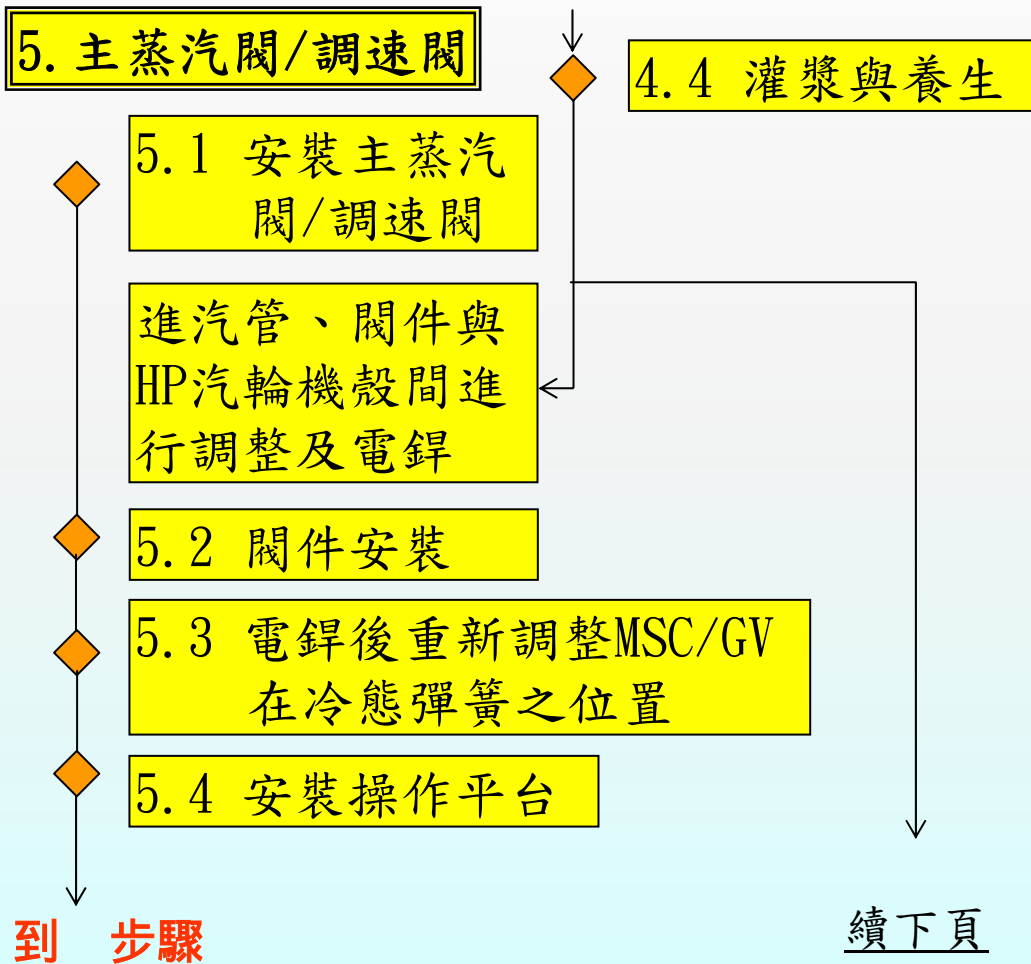
貳、核四廠汽輪發電機安裝步驟



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

6. 再熱關斷閥/截斷閥

承上頁

6.1 T形管/閥件/管路間之連接

6.2 檢查閥體內部

4.5 HP/LP-1/LP-2/LP-3/發電機/勵磁機最後對心

4.6 轉子聯軸器連接

4.7 安裝推力軸承

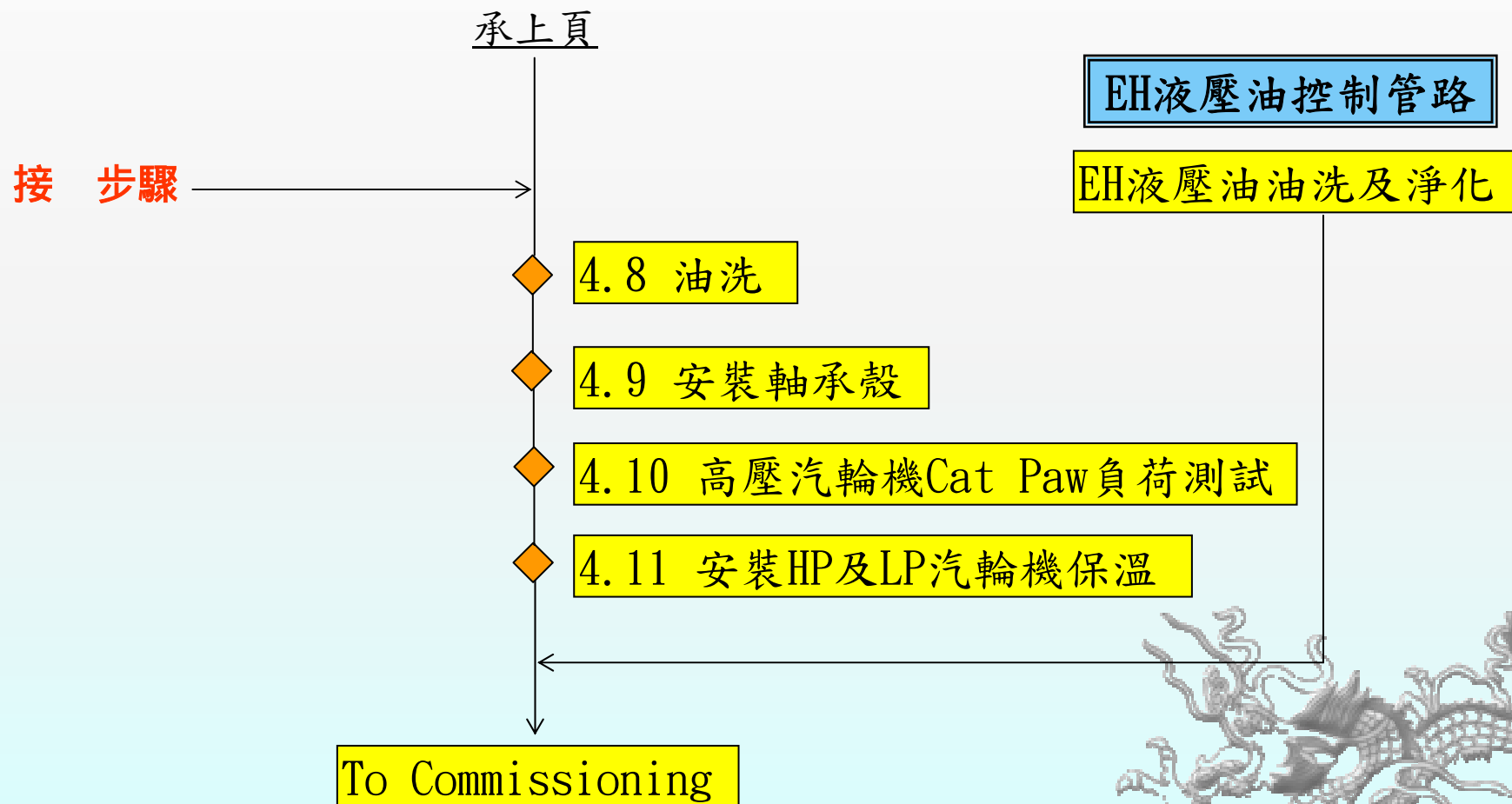
潤滑油管路

管路系統洩漏試驗

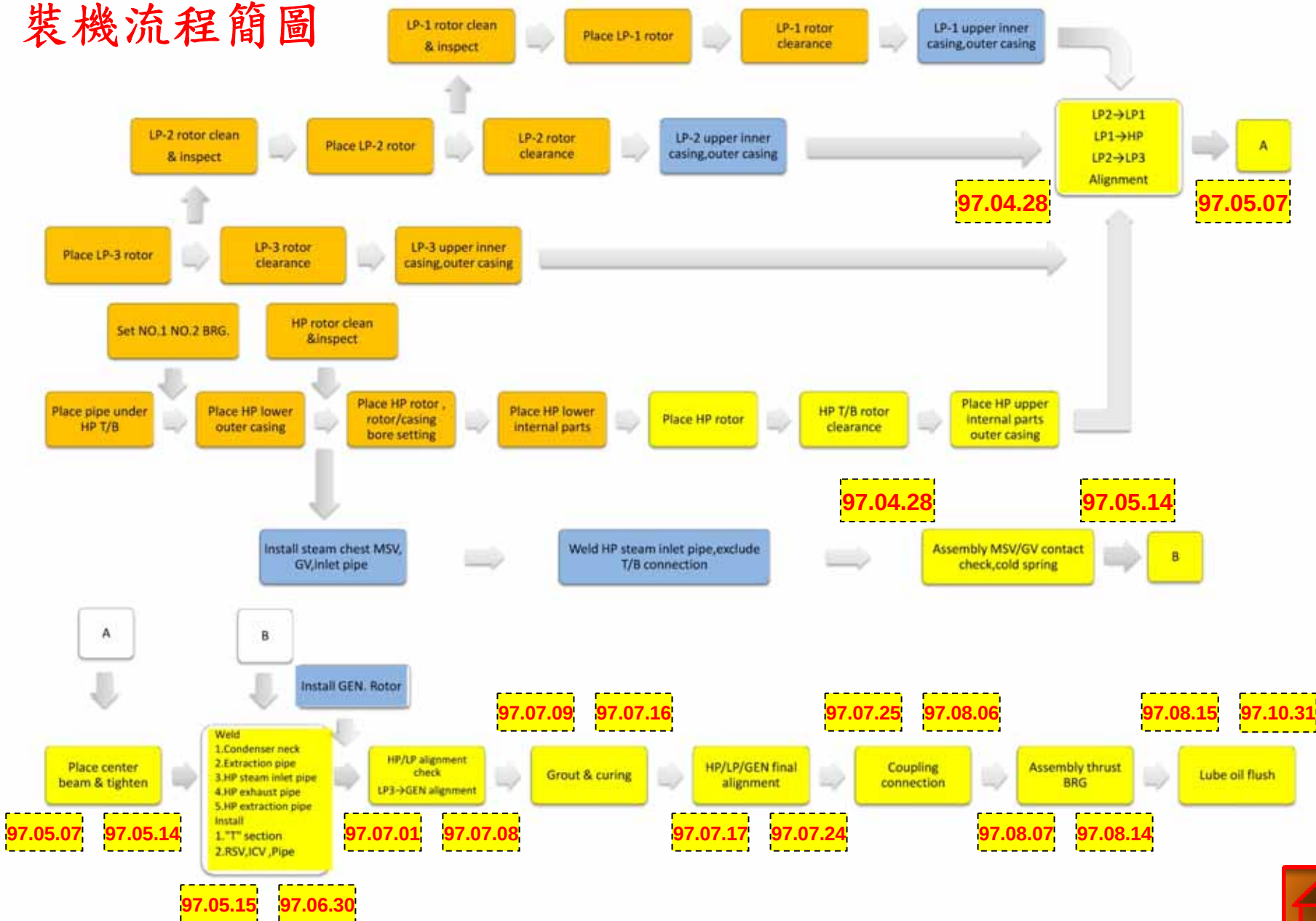
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到 步驟

貳、核四廠汽輪發電機安裝步驟

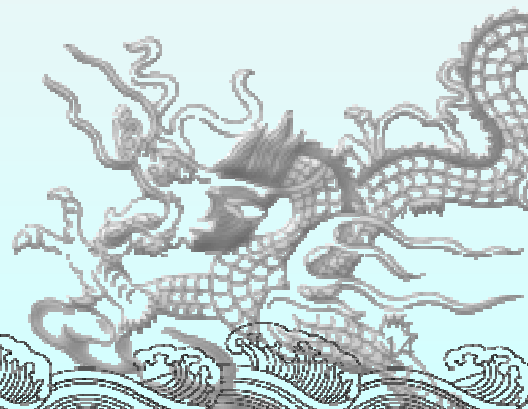


裝機流程簡圖



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

基礎ボルト
FOUNDATION BOLT

調整ボルト用座板
LEVELING PLATE

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 $\pm 2\text{mm}$ and the level of bolts shall be determined according to Bearing Alignment Diagram. Furthermore add $5\sim 10\text{mm}$ to design level of foundation bolts due to shrinkage of concrete after pouring.

3 All foundation bolts and embedded pieces shall firmly be fixed by templates so that they don't move owing to concrete pouring.

4 All foundation bolts and embedded pieces shall not be fixed 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.

テンプレート
TEMPLATE

テンプレート
TEMPLATE

アキシアルキー アンカー
AXIAL KEY ANCHOR

ジャッキングポスト
JACKING POST

基礎ボルト
FOUNDATION BOLT

アンカーブロック
ANCHOR BLOCK

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 $20\sim 30\text{mm}$. (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.

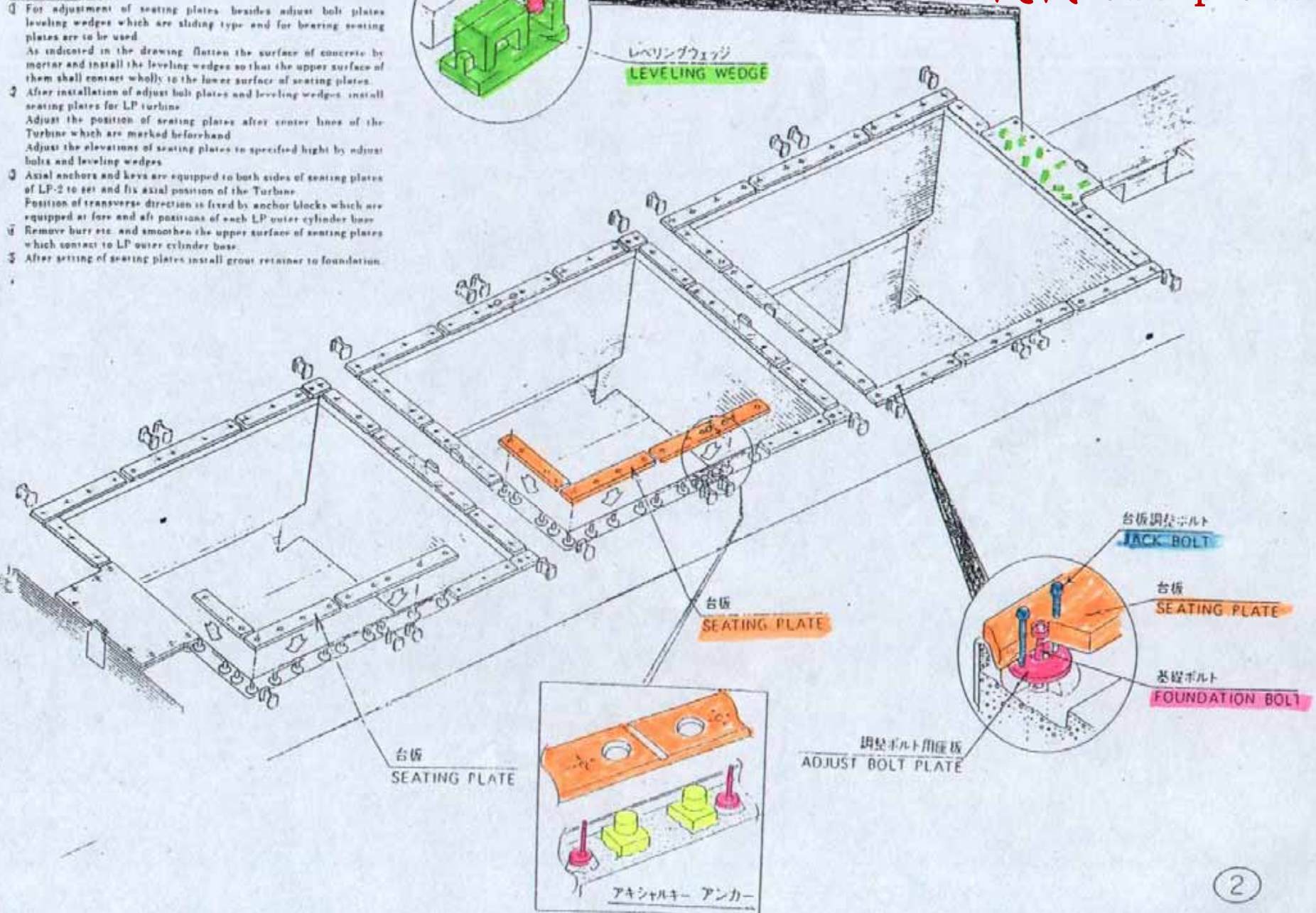


2006.06.08

2、安裝汽機基礎座板 LP汽機Base plate

INSTALLATION OF LEVELING WEDGES AND LP TURBINE SEATING PLATES

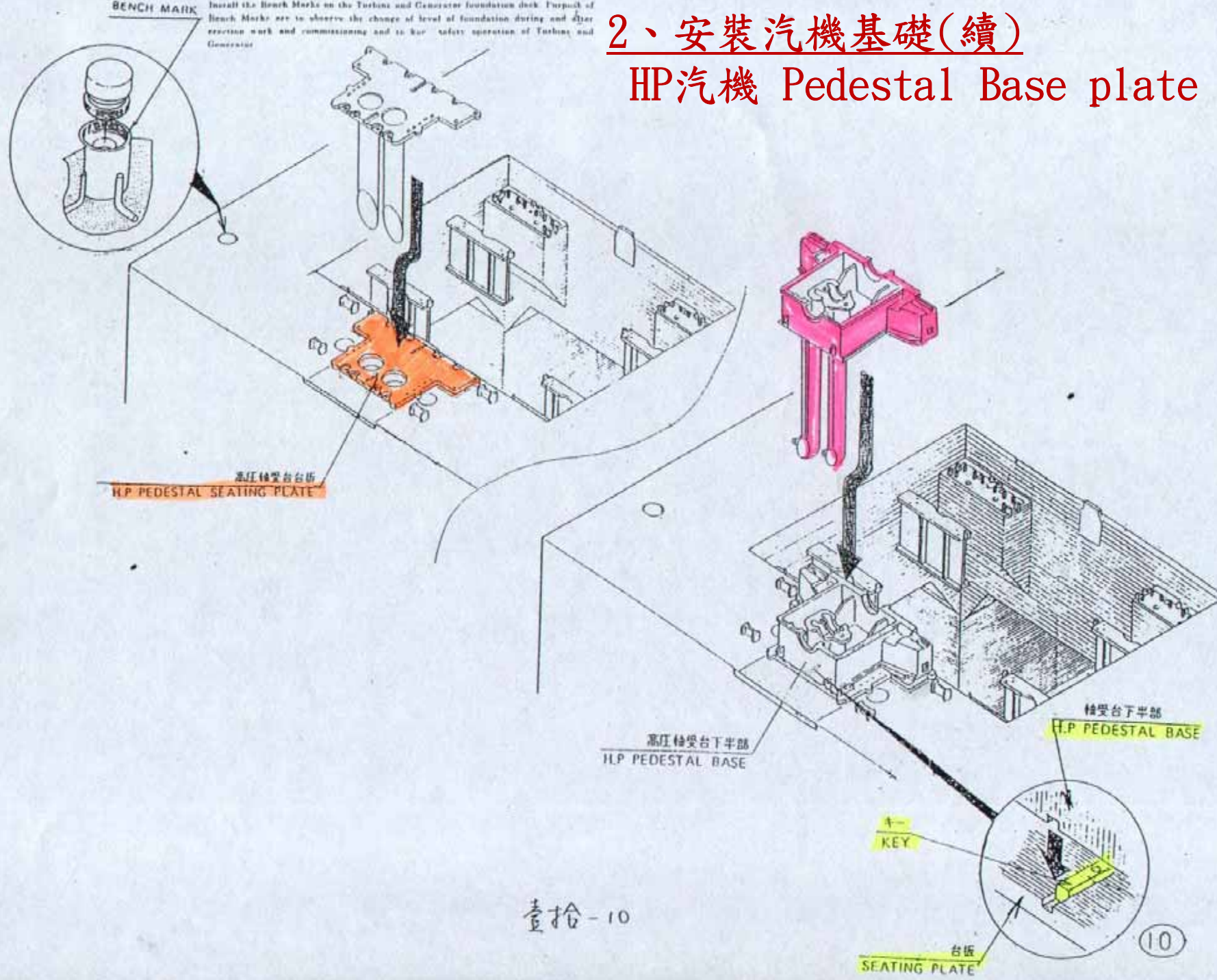
- 1 For adjustment of seating plates, besides adjust bolt plates leveling wedges which are sliding type and for bearing seating plates are to be used.
As indicated in the drawing, flatten the surface of concrete by mortar and install the leveling wedges so that the upper surface of them shall contact wholly to the lower surface of seating plates.
- 2 After installation of adjust bolt plates and leveling wedges, install seating plates for LP turbine.
Adjust the position of seating plates after center lines of the turbine which are marked beforehand.
Adjust the elevations of seating plates to specified height by adjust bolts and leveling wedges.
- 3 Axial anchors and keys are equipped to both sides of seating plates of LP-2 to set and fix axial position of the turbine.
Position of transverse direction is fixed by anchor blocks which are equipped at fore and aft positions of each LP outer cylinder base.
- 4 Remove burr etc. and smoothen the upper surface of seating plates which contact to LP outer cylinder base.
- 5 After setting of seating plates install grout retainer to foundation.





2、安裝汽機基礎(續)

HP汽機 Pedestal Base plate





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.

低壓外缸ケーシング下半部

LP OUTER CYLINDER BASE

ベンチマーク
BENCH MARK

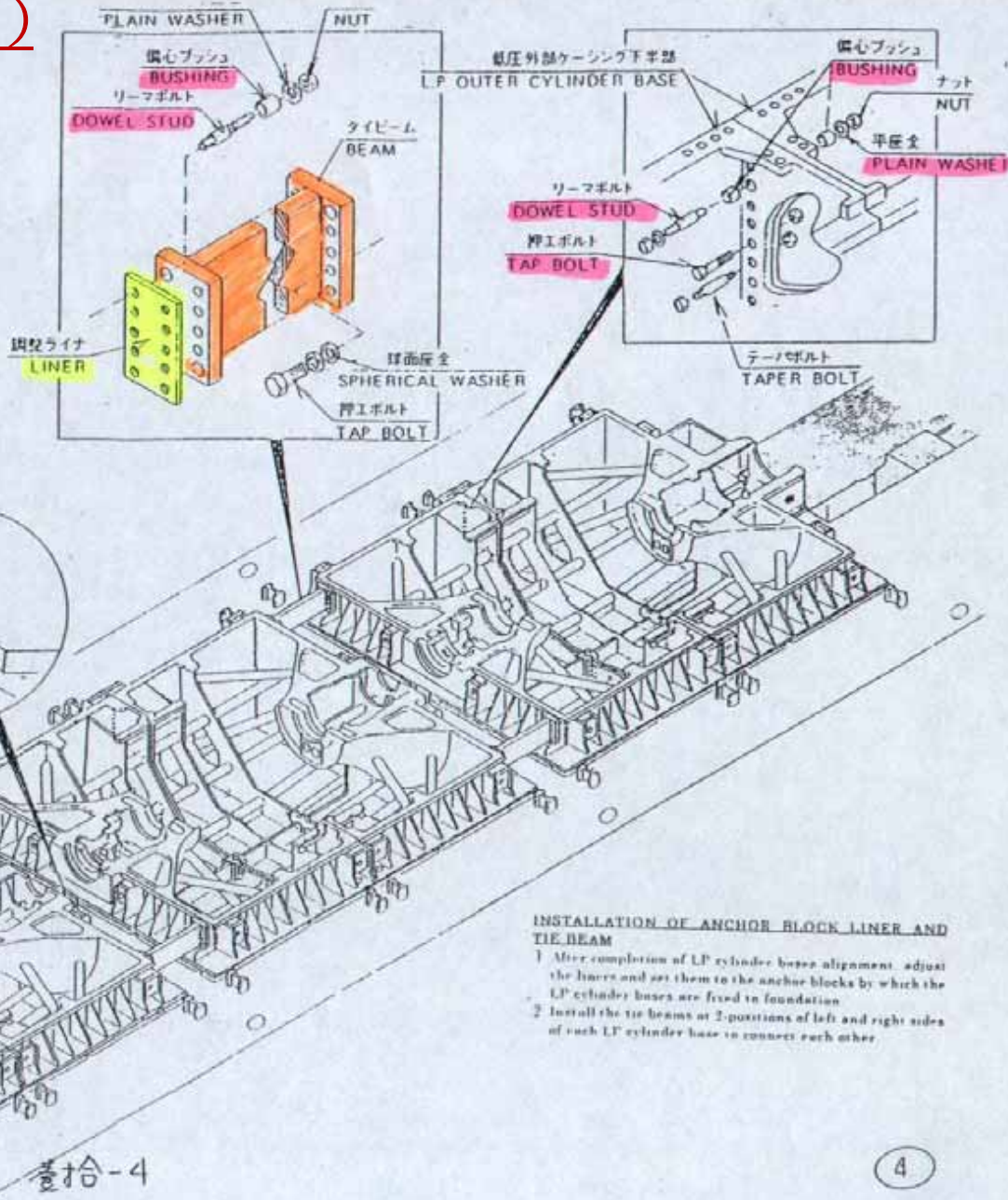
INSTALLATION OF FOUNDATION BENCH MARKS

Install the Bench Marks on the Turbine and Generator foundation disk. 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.

3、安裝低壓汽機外缸(續)

ALIGNMENT AND CONNECTION OF LP TURBINE CYLINDERS

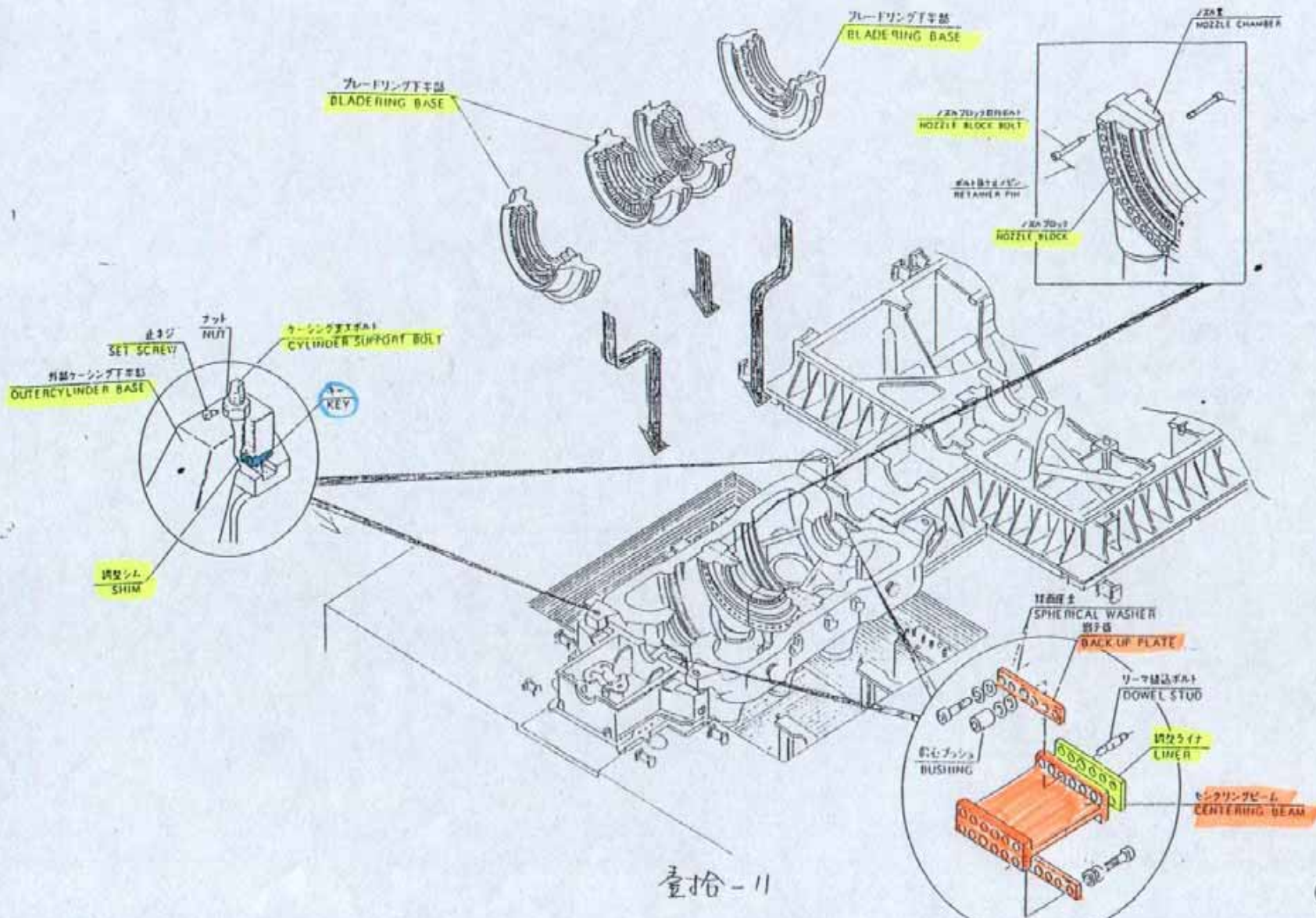
- ① After connection and horizontal adjustment of LP Turbine cylinder bases, set jig for center measurement at each gland hole part and align the Turbine center to foundation center by plane wire.
- ② Alignment of LP cylinders shall be carried out under the condition that LP outer cylinder cover will be installed.

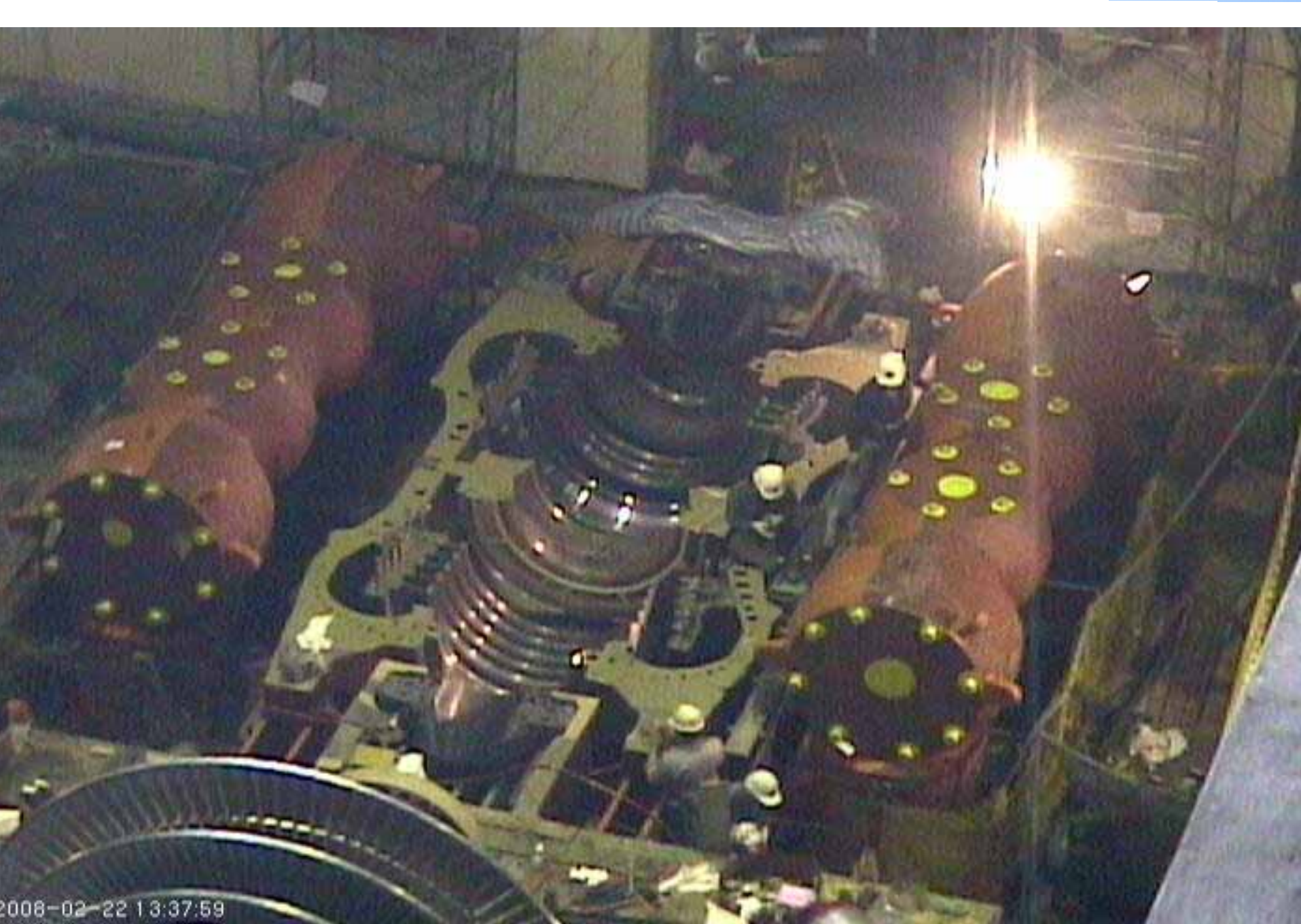




2007/07/12

4、安裝高壓汽機外缸基座 (HP Cylinder Base)





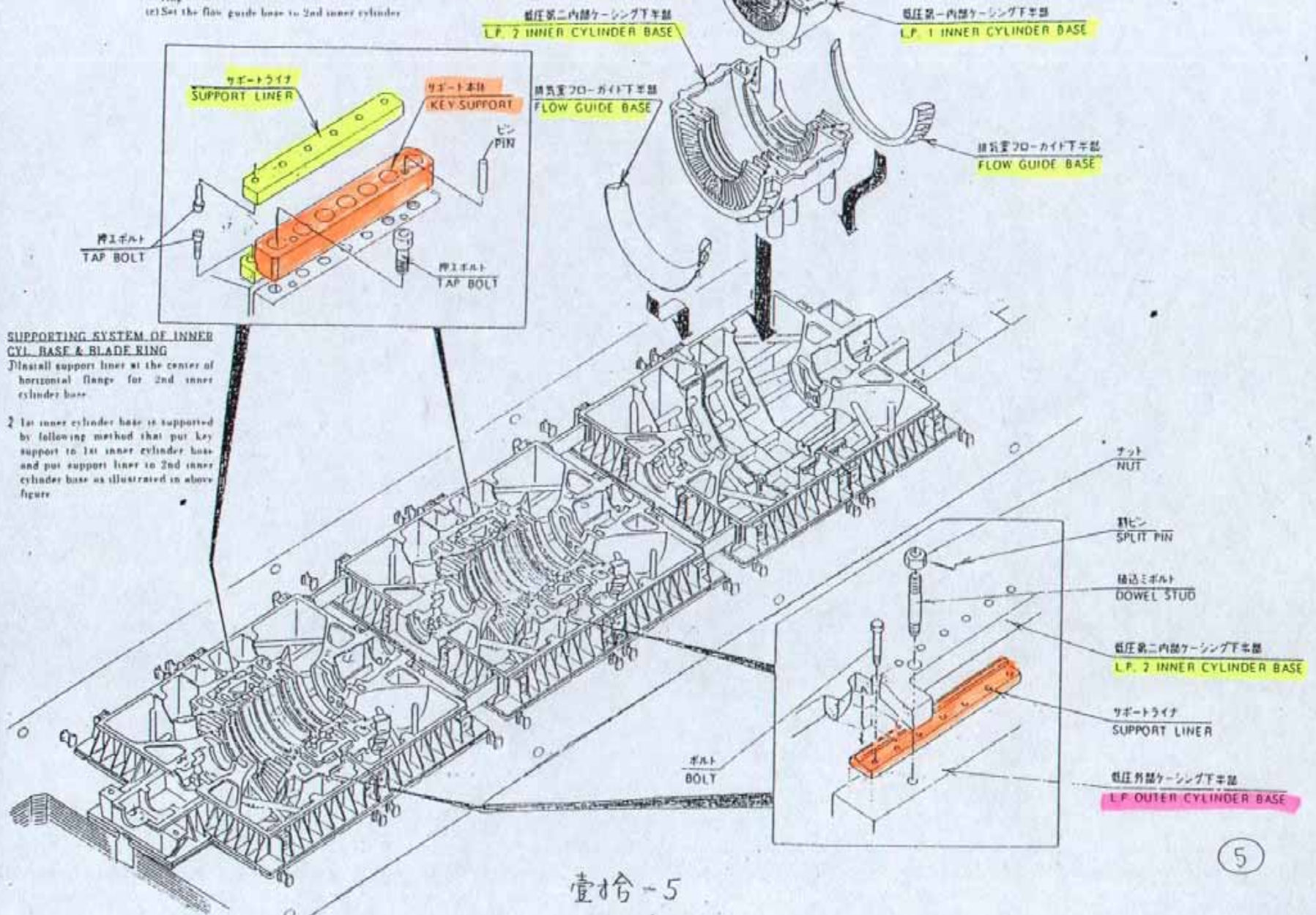
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ASSEMBLING OF INNER CYL. BASE, BLADE RING AND FLOW GUIDE BASE

- 1) After installation of LP outer cylinder bases are completed, assemble inner cylinder bases, blade rings and flow guide bases according to following sequence:
 - (a) Insert the flow guide base and lift temporarily.
 - (b) Insert 2nd inner cylinder, 1st inner cylinder and blade ring.
 - (c) Set the flow guide base to 2nd inner cylinder.

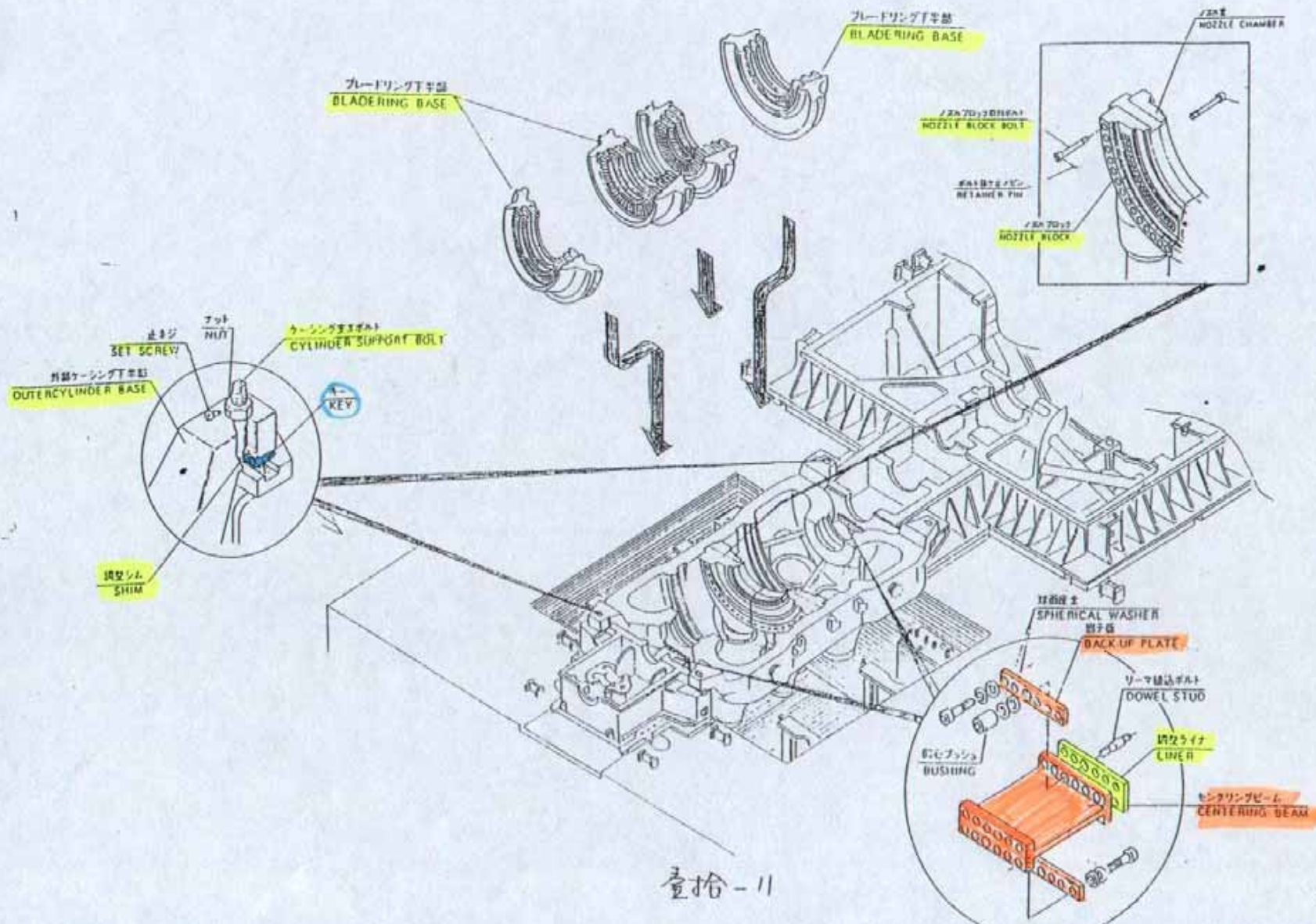
5、安裝低壓汽機下半汽缸內部組件





2007/11/06

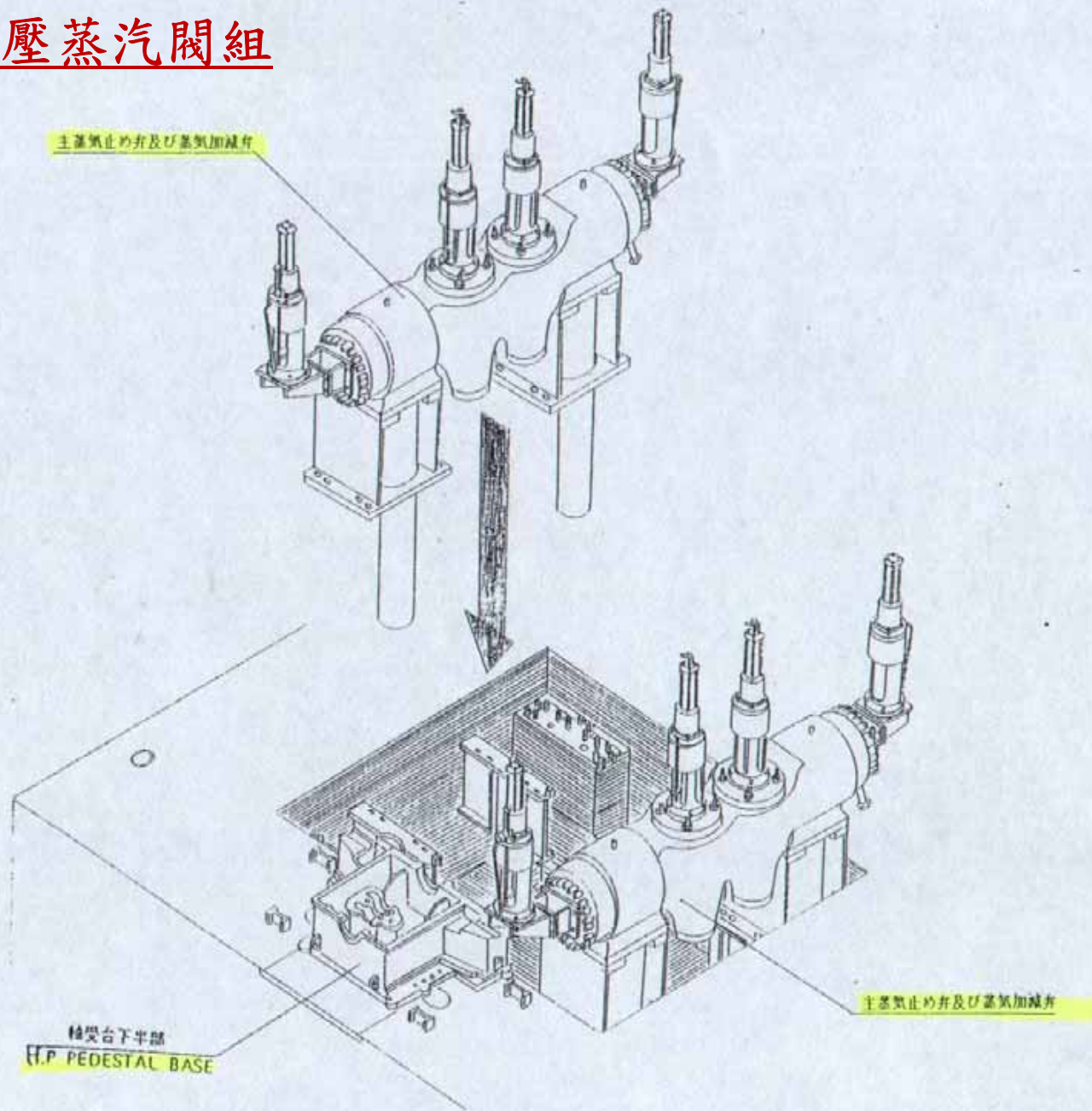
6、安裝高壓汽機下半汽缸內部組件





2008/02/22

7、安裝高壓蒸汽閥組





1 カップリング Spacer
COUPLING SPACER

低圧第ニロータ
L.P. 2 ROTOR

LP 3 ROTOR

カップリングボルト
COUPLING BOLT

INSERTION OF ROTOR AND SETTING WORK

After the installation of LP inner cylinder bases and blade rings, install the gland, bearing base and insert rotors.

1 Install rotor guide into the cylinder base to prevent damage for the rotor blade during insertion work.

2 Lift up the rotor horizontally by lifting beam and insert steadily along the rotor guide.

3 Position of the rotor shall be adjusted and fixed by adjusting the key of bearing so that the rotor and oil ring bore to be concentric.

4 Axial position of the rotor shall be adjusted by "K" dimension which is defined by the clearance between 1st stationary blade outlet and rotating blade inlet.

HP ROTOR

低圧第ニロータ
L.P. 2 ROTOR

低圧第一ロータ
L.P. 1 ROTOR

押入ボルト
TAP BOLT

軸受上蓋
BEARING COVER

ロータガイド
ROTOR GUIDE

押入ボルト
TAP BOLT

Clearance between rotor and cylinder shall be measured by following method.

Axial and transverse directions, horizontal split surface

Vertical direction, lead wire and clearance between final stage stationary & rotating blades

(Refer to "Rotor Clearance Table")

8、安裝高、低壓汽機及發電機轉子

低壓汽機轉子

スラスト軸受ケース上蓋
THRUST BEARING COVER

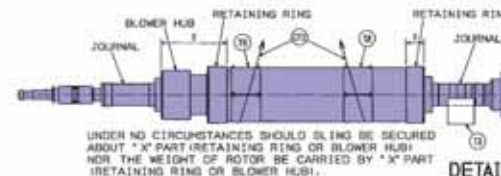
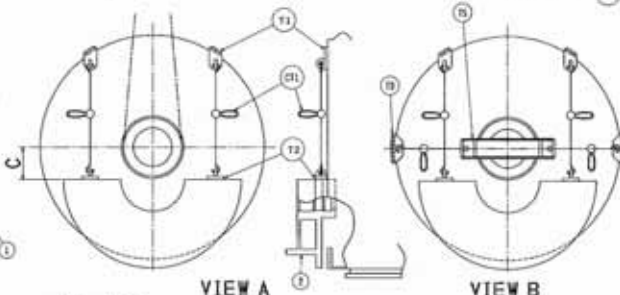
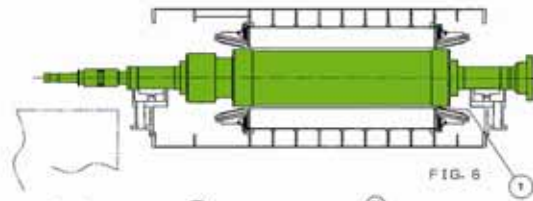
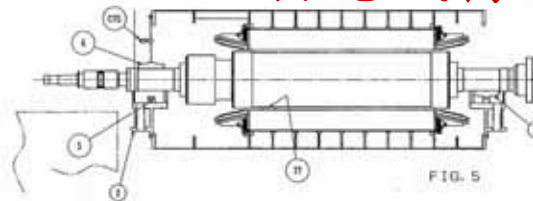
図A-6



2007/11/15

發電機轉子

DETAIL D



TO REMOVE ROTOR FROM STATOR, DRAIN OIL FROM DEFOAMING TANK IN SLIP RING END BEARING BRACKET THEN FOLLOW WITH REVERSE OF ASSEMBLY PROCEDURE.

(C7) CHAIN BLOCK (C14) CHAIN BLOCK
 (C7) SLING (C15) CHAIN BLOCK
 (C13) BLOCK

1. REFER TO OMS "BLOWER ASSEMBLY".
2. BOLT "HANDER" ITEM (14) TO FRAME AND "LIFTING EYE" ITEM (15) TO "BRACKET" ITEM (1) ON SLIP RING END. SEE VIEW "A".
3. LOWER BOTTOM HALF OF "SLIP RING END BEARING BRACKET" ITEM (1) INTO POSITION "C". SUPPORT BRACKET BY USE OF "CHAIN BLOCK" ITEM (26).
- FIG. 14
4. BOLT ON AND DOWEL BOTTOM HALF OF "TURBINE END BEARING BRACKET" ITEM (3).
5. STRAP "BLOCK" ITEM (10) TIGHTLY TO ROTOR IN POSITION SHOWN. PLACE "SKID PLATE" ITEM (28) IN STATOR BORE, AND GREASE OR PLACE BINA SHEET ON THE "SKID PLATE" ITEM (28). IN CASE OF USING THE BINA SHEET, USE A-G-F. COIL THE BOTTOM OF THE "BLOCK" ITEM (10).
6. PLACE CLOTHES ON STATOR COILS TO CATCH GREASE. (IN CASE OF USING THE GREASE ONLY).
7. PLACE "SLINGS" ITEM (25), "ROTOR PROTECT COVER" ITEM (17) TO STRADDLE CENTER OF GRAVITY OF ROTOR. SLIDE ROTOR IN BORE UNTIL "SLIDING SHOES" ITEM (18) TOUCHES FRAME. USE "BLOCK" ITEM (29) AS REQUIRED TO POSITION ROTOR LEVEL. SEE DETAIL "C".
8. AFTER REMOVE ROTOR PROTECT COVER MOVE SLING TO BEARING JOURNAL, SHOULDER AND GROWN AND HORIZONTAL AND ROTOR BOLT "SUPPORT" ITEM (25) TO SLIP RING END OF ROTOR AND "INSTALLING EYE" ITEM (15) TO FRAME. SEE VIEW "B".
- FIG. 24
9. PULL ROTOR FAR ENOUGH INTO BORE TO PERMIT PULLING "SLIDING SHOE" ITEM (20) UNDER ROTOR BODY. DO NOT ALLOW "BLOCK" ITEM (29) TO GO BEYOND END OF BORE UNTIL "SLIDING SHOE" ITEM (20) IS IN POSITION SHOWN. IN CASE OF USING THE BINA SHEET, WRAP A-G-F SHEET THE BOTTOM OF THE "SLIDING SHOE" ITEM (20).
10. SUPPORT ROTOR WEIGHT BY "SLIDING SHOE" ITEM (20) INSTEAD OF "BLOCK" ITEM (29). THEN CONTINUE PULLING ROTOR INTO BORE. "SLIDING SHOE" IS TO HAVE WIRES OF SUFFICIENT LENGTH ATTACHED TO PERMIT WITHDRAWAL FROM SLIP RING END.
- FIG. 3
11. STOP BEFORE "BLOCK" ITEM (29) STRIKES BEARING BRACKET ITEM (1). ROTATE "BLOCK" ITEM (29) AROUND ROTOR. STRAP "BLOCK" ITEM (29) TIGHTLY TO ROTOR IN POSITION SHOWN.
12. PULL ROTOR INTO FINAL POSITION. PLACE "SHOE" ITEM (19) UNDER ROTOR BODY.
13. REMOVE SLING FROM SLIP RING END TO TURBINE END. REMOVE "BLOCK" ITEM (29).
- FIG. 4
14. INSTALL "INSULATED BEARING SEAT" ITEM (2) IN BOTTOM HALF OF "TURBINE END BEARING BRACKET" ITEM (1).
15. THEN PLACE BOTTOM HALF OF "TURBINE END BEARING" ITEM (4) ON JOURNAL AND ROLL INTO POSITION.
16. CONTROL BEARING BY MEANS OF SLING ATTACHED TO EYE BOLTS IN HOLES PROVIDED IN BEARINGS.
17. REMOVE SLING FROM TURBINE END TO SLIP RING END. SLIP SLIP RING END AS HIGH AS POSSIBLE AND REMOVE "SHOE" ITEM (19), "SLIDING SHOE" ITEM (20) AND "SKID PLATE" ITEM (28) FROM SLIP RING END. CLEAN "SHOE" ITEM (19).
18. THEN PLACE AIN "SHOE" ITEM (19) UNDER ROTOR BODY AT SLIP RING END OF CORE AND FIX BOTTOM HALF OF SLIP RING END BEARING BRACKET TO STATOR FRAME.
- FIG. 5
19. ASSEMBLE AND DOWEL BOTTOM HALF OF "SLIP RING END BEARING BRACKET" ITEM (3) WITH "INSULATED BEARING SEAT" ITEM (2).
20. PLACE BOTTOM HALF OF "SLIP RING END BEARING" ITEM (4) ON JOURNAL AND ROLL INTO POSITION. CONTROL BEARING BY MEANS OF SLING ATTACHED TO EYE BOLTS IN HOLES PROVIDED IN BEARINGS.
- FIG. 6
21. SLING SLIP RING END ROTOR. REMOVE "SHOE" ITEM (19) FROM SLIP RING END.
22. LOWER ROTOR ON BOTH BEARINGS.
23. ASSEMBLE "AIR GAD SAFFLE" ITEM (1).

DETAIL D

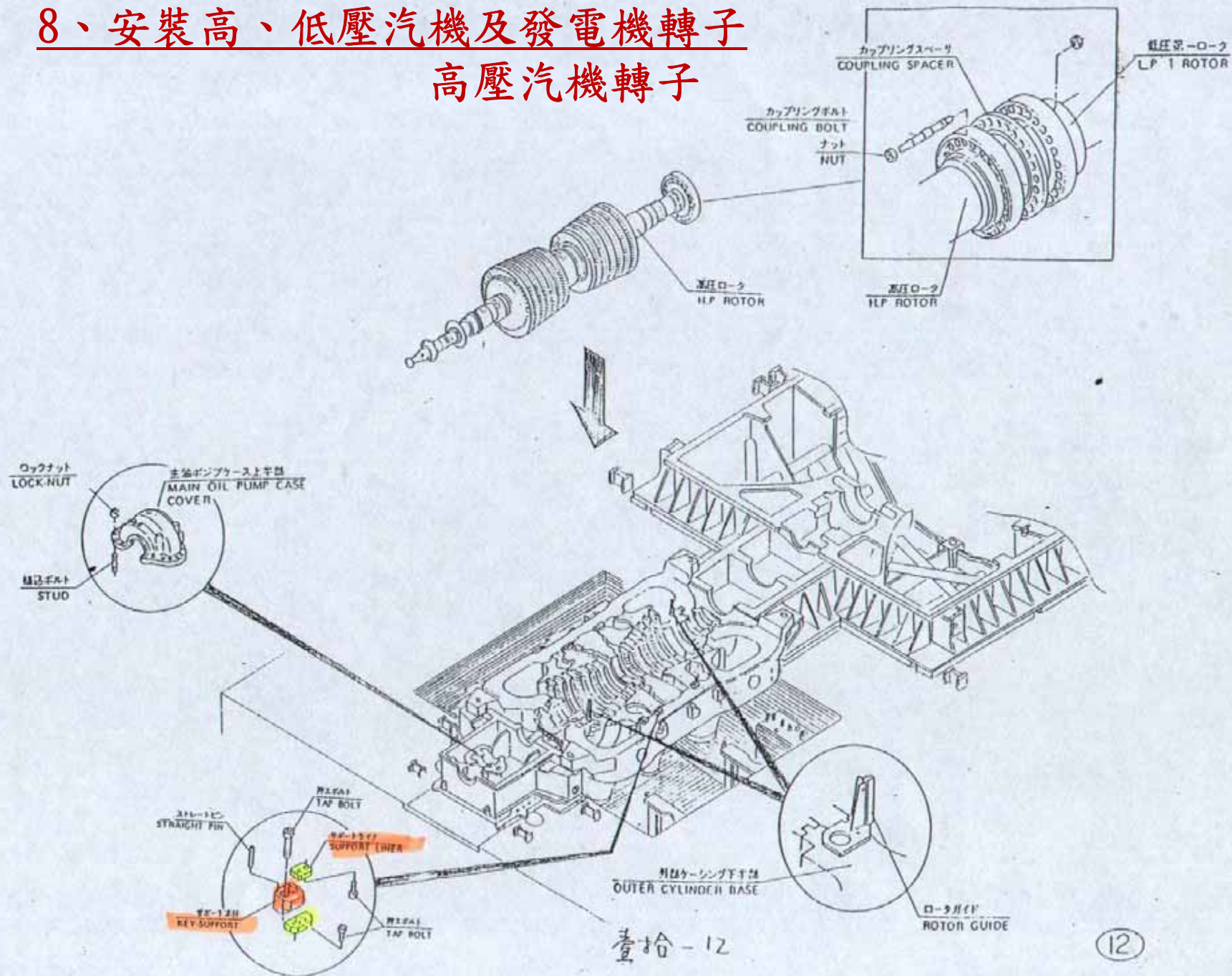
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SCALE		SHEET NO.	
STP		AK71986	





2008/01/17

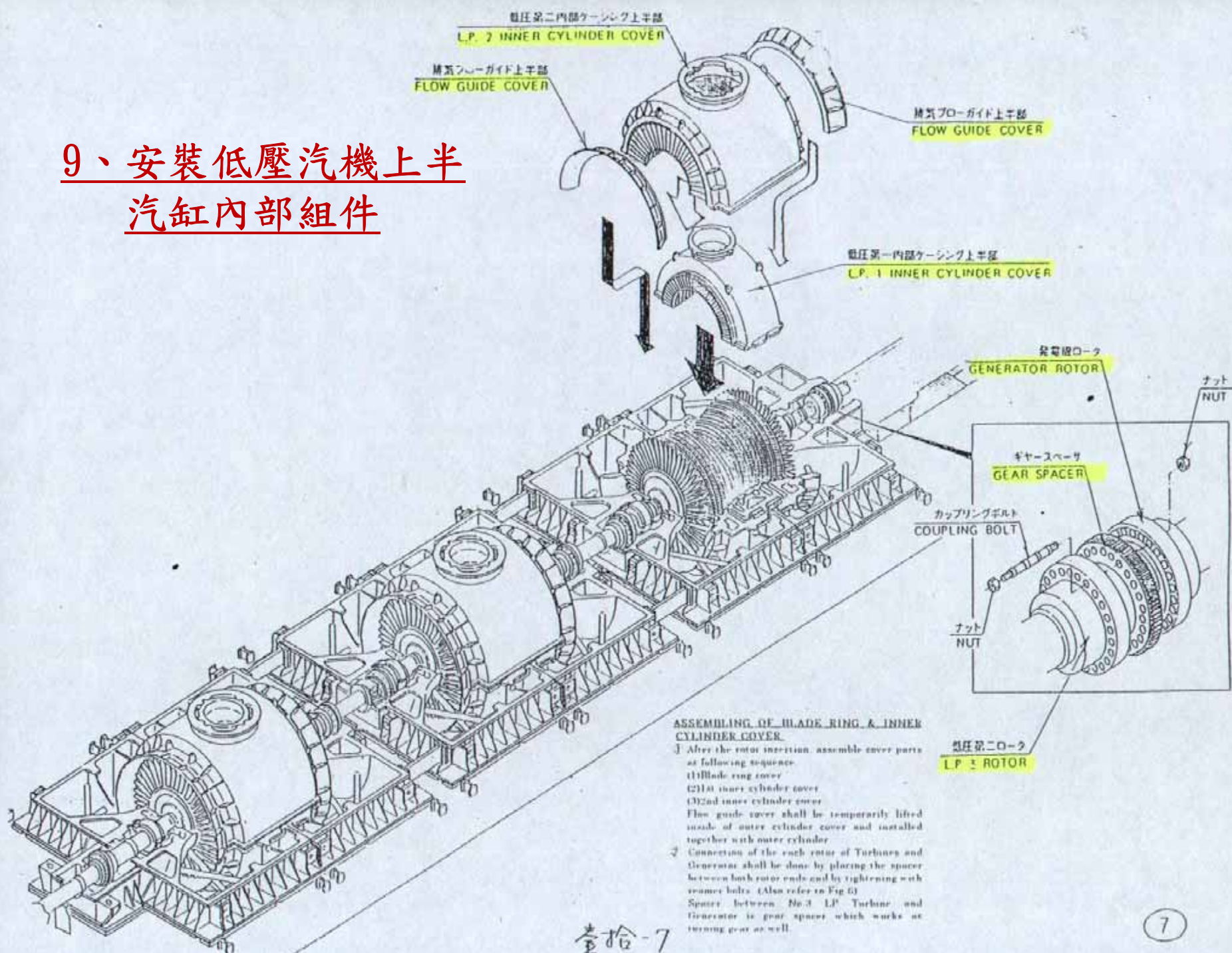
8、安裝高、低壓汽機及發電機轉子高壓汽機轉子





2008/01/28

9、安裝低壓汽機上半 汽缸內部組件



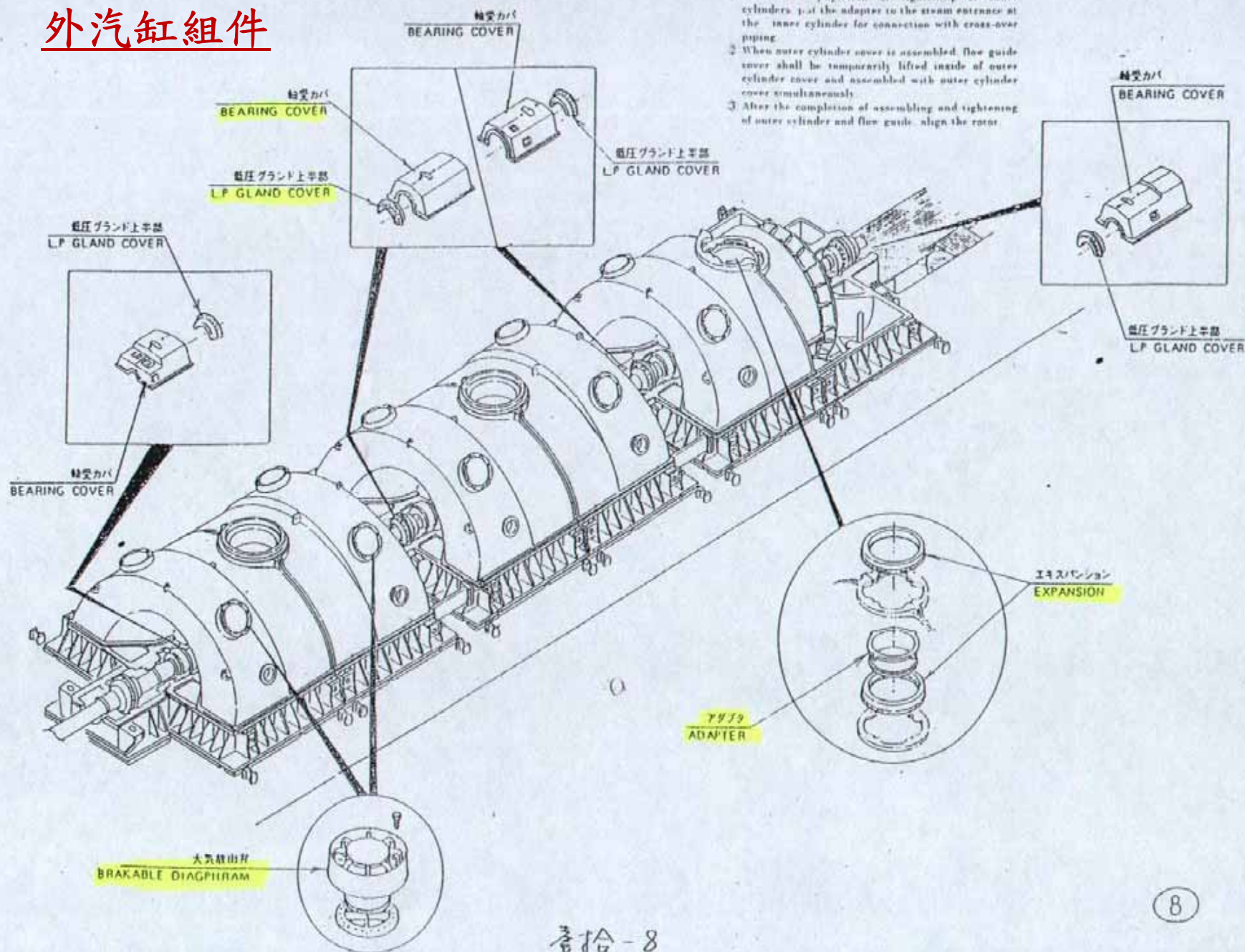


2008/02/09

10、安裝低壓汽機上半 外汽缸組件

ASSEMBLING & ALIGNMENT OF LE TURBINE OUTER CYLINDER COVER

- 1 After the completion of tightening of inner cylinder, put the adapter to the steam entrance of the inner cylinder for connection with cross-over piping.
- 2 When outer cylinder cover is assembled, flow guide cover shall be temporarily lifted inside of outer cylinder cover and assembled with outer cylinder cover simultaneously.
- 3 After the completion of assembling and tightening of outer cylinder and flow guide, align the rotor.



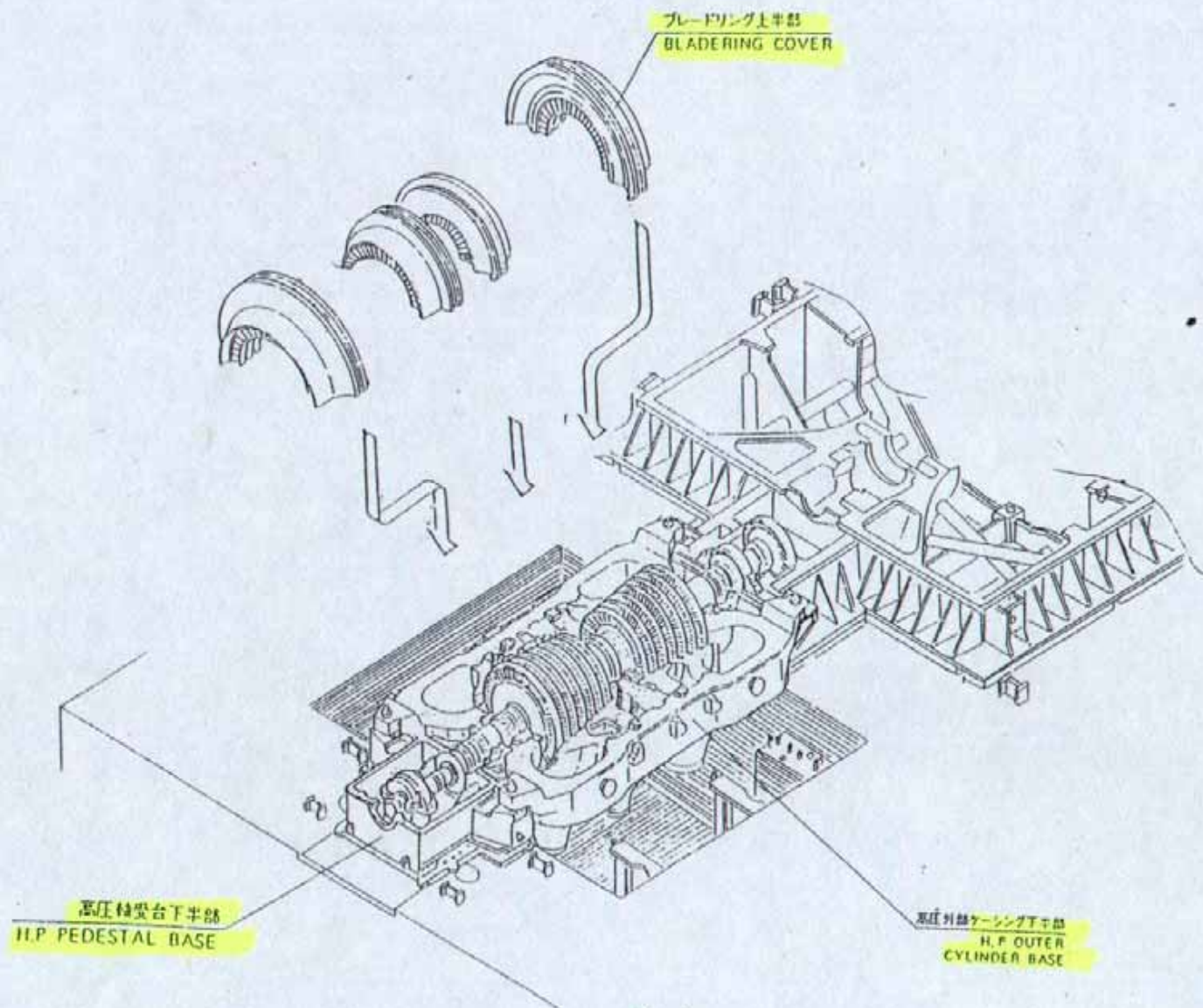


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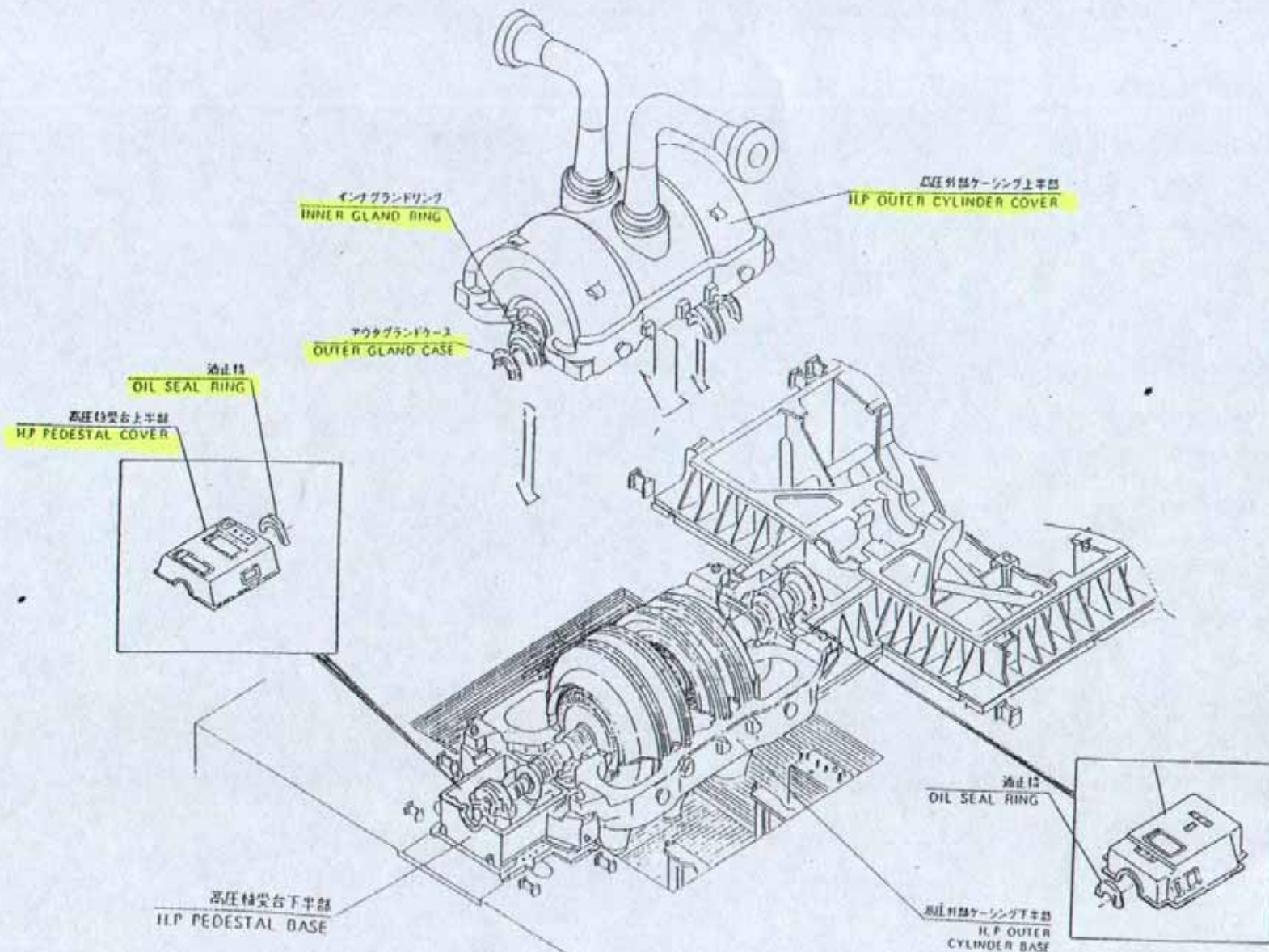


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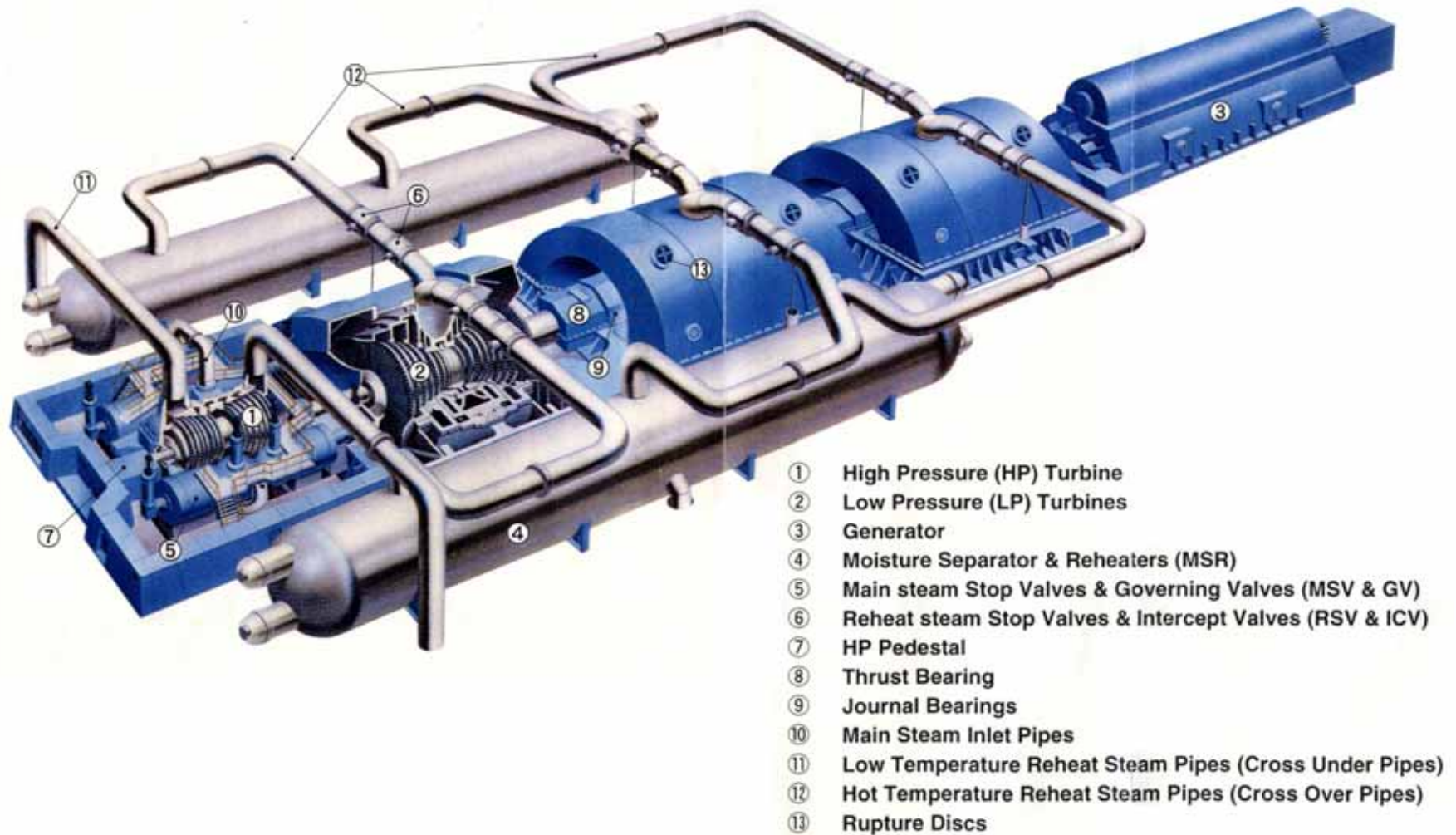
11、安裝高壓汽機上半汽缸組件



11、安裝高壓汽機上半汽缸組件(續)



Mitsubishi Nuclear Steam Turbine



Final Erection

