BrightnESS 2nd WS
June 2017, INFN-LNS, Catania, Italy

Experiences on Target/Instrument Installation at J-PARC

Masatoshi FUTAKAWA
J-PARC Center

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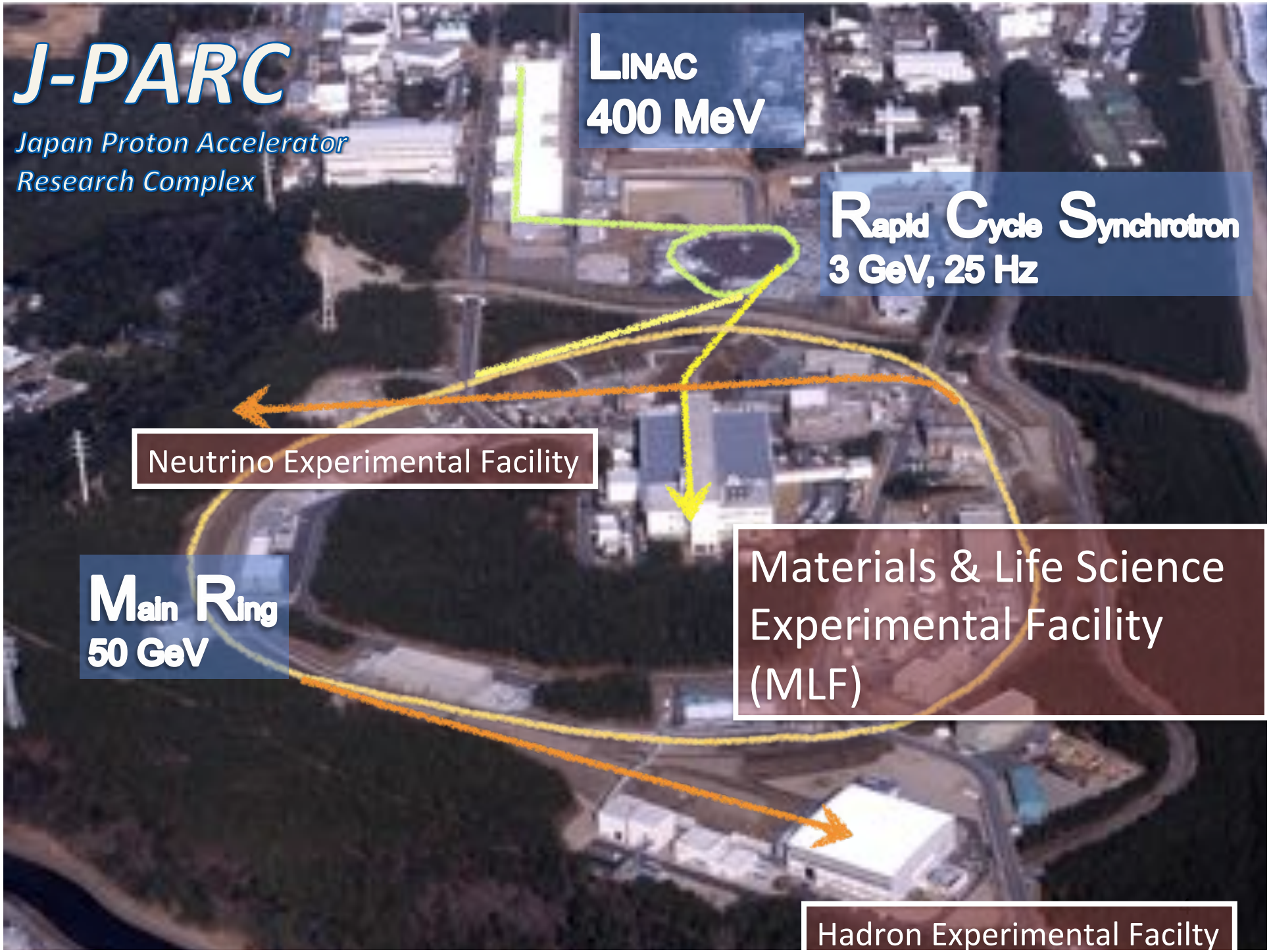

J-PARC
Japan Proton Accelerator
Research Complex
Linac
400 MeV
Rapid Cycle Synchrotron
3 GeV, 25 Hz
Neutrino Experimental Facility
Main Ring
50 GeV
Materials & Life Science
Experimental Facility
(MLF)
Hadron Experimental Facilty

JSNS 1MW spallation neutron source

Moderators

Cryogenic hydrogen system

Mercury target system

Proton beam
3 GeV, 1MW, 25 Hz

5m

Neutron beam lines (23)
19: operation 2:construction

Elevation View of Target Station

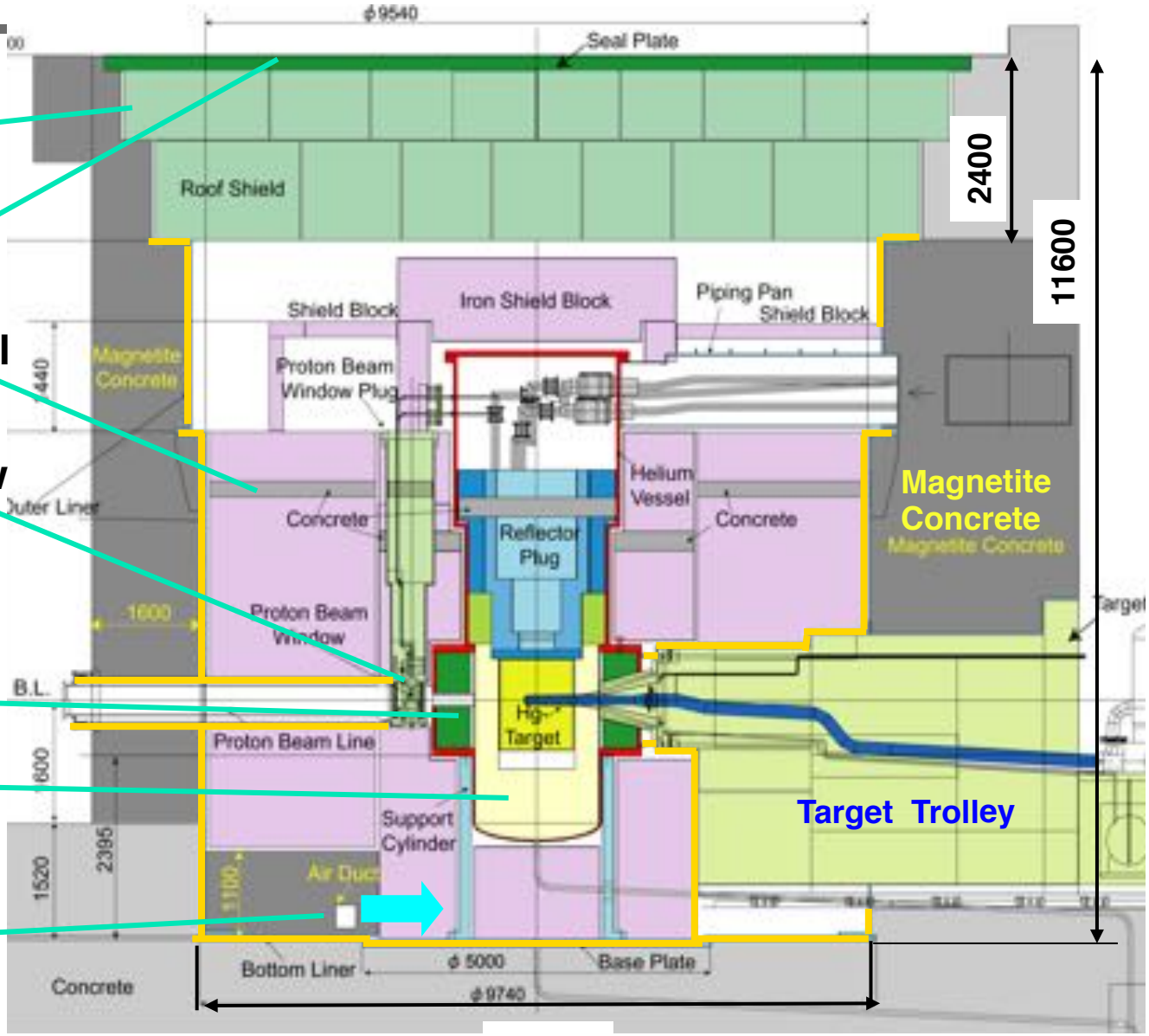
- Thick roof shield without explicit metallic liners.
- Seal plate on the top.
- Concrete layer in steel shield.
- Proton beam window near vessel.

Water-Cooled Portion in Helium Vessel.

Middle section

Shielding around reflector

Dry air ventilation

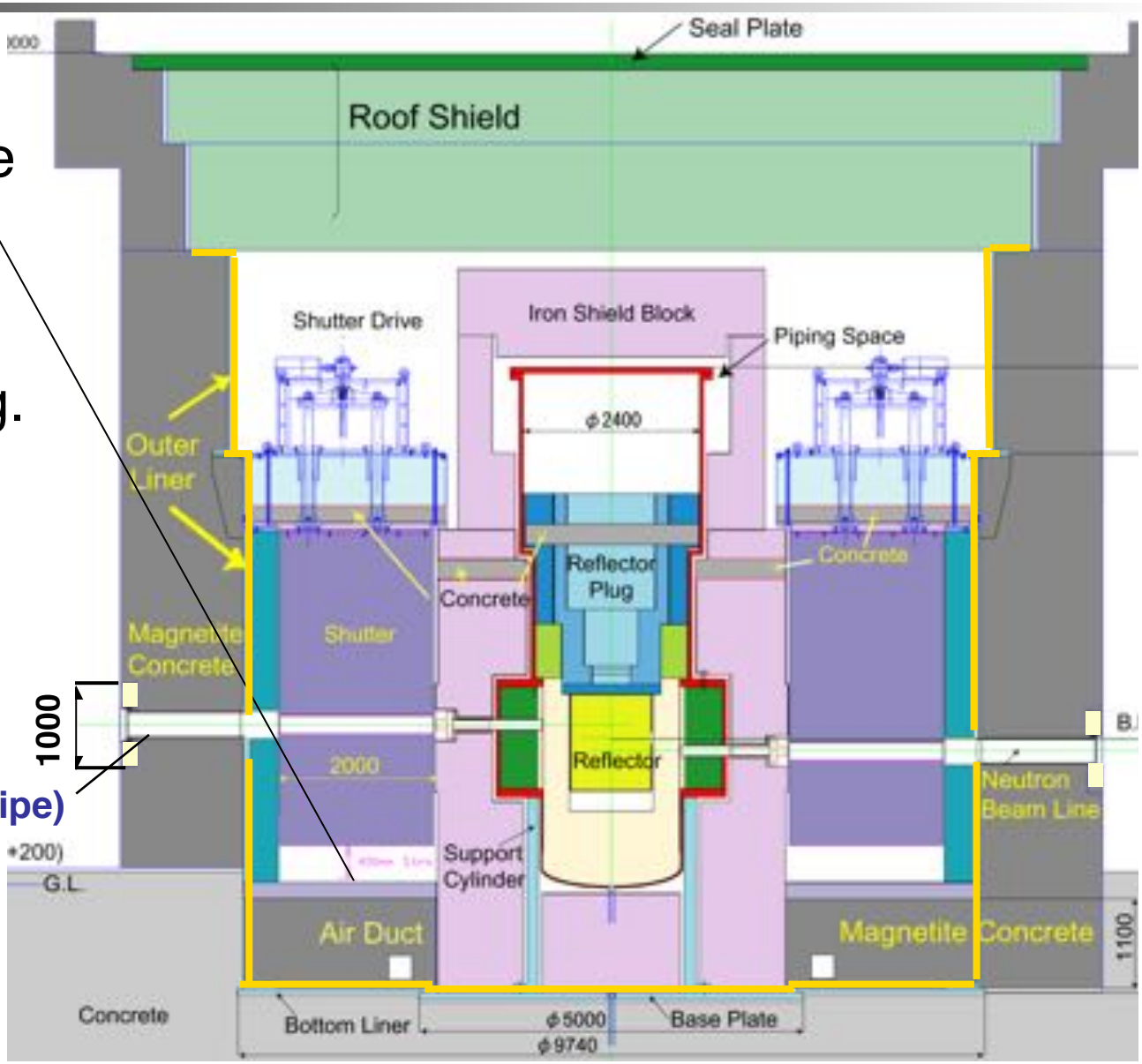


ϕ 9740

Outer liner in Helium Vessel

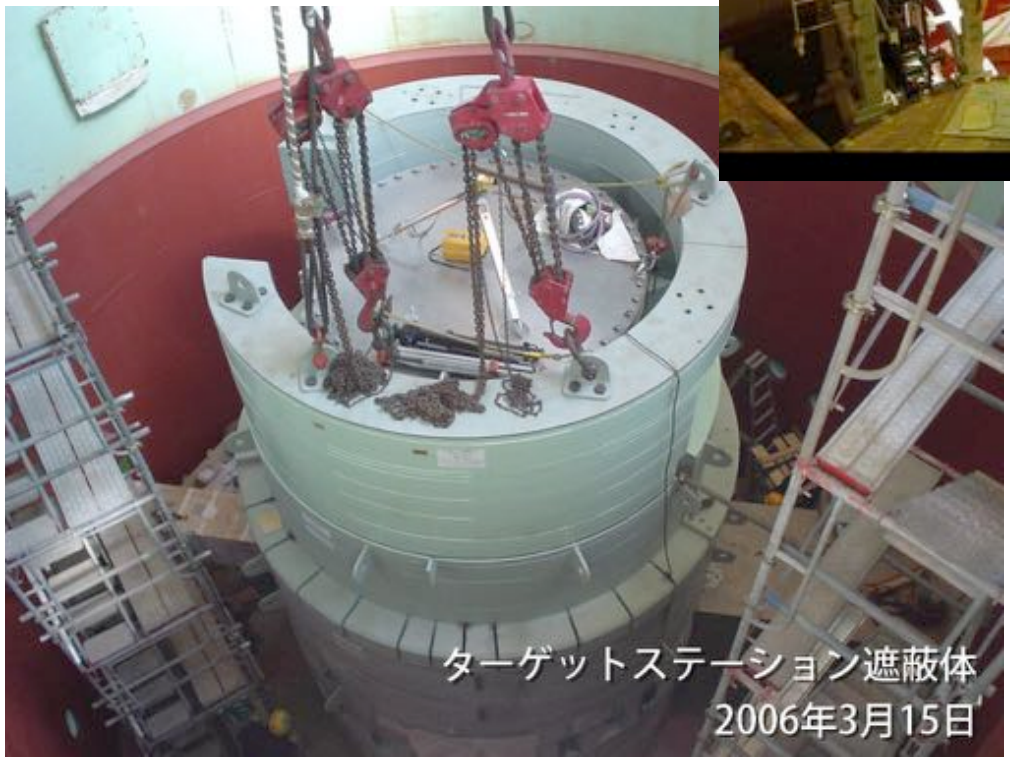
Section Through Shutters

- Magnetite concrete base for shutters.
- Flat top shutters.
- No shutter housing.
- No shutter support cylinder.



Total Weight :
- 4600 tons

Installation of Shutter

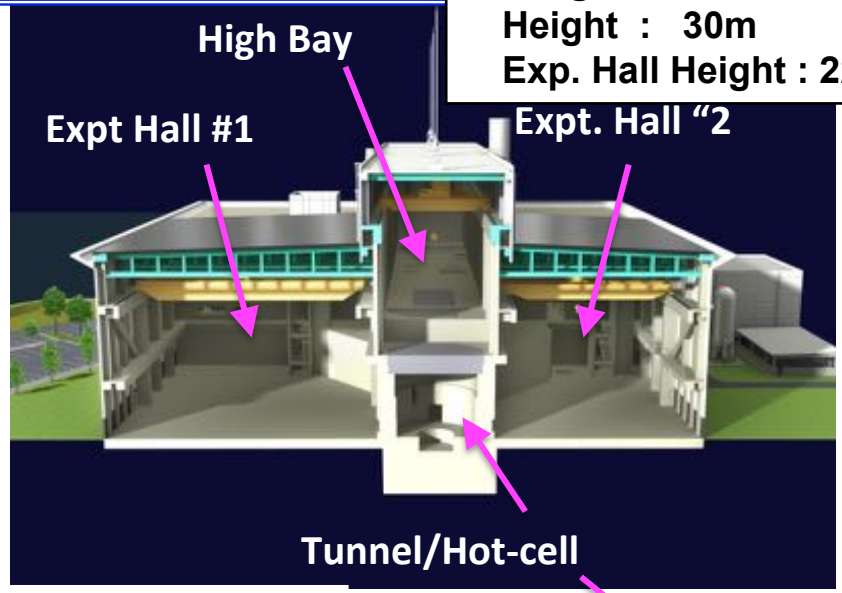


Installation of Target Station Shielding

Building Layout Overview

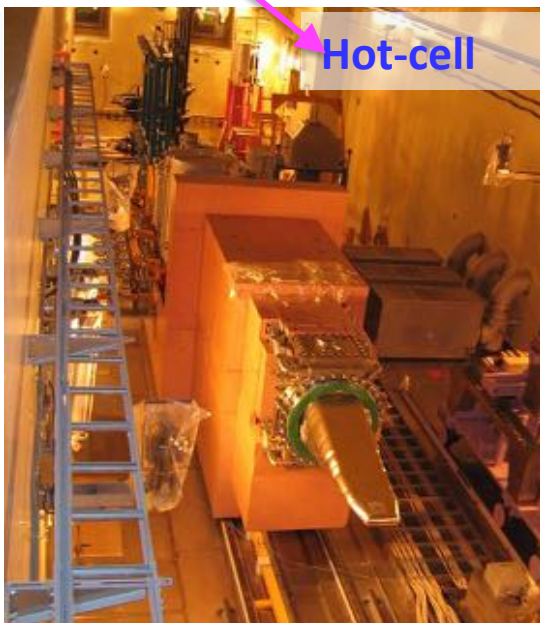
- Clear separation of the user area from the source components operation/ maintenance area
- Appropriate and effective facility layout considering components maintenance;
  - Hot-cell for handling highly irradiated components
  - High bay structure

Building dimension :
Width : 70m
Length : 146m
Height : 30m
Exp. Hall Height : 22m



Radiation shielding design criteria

- Dose rate at boundary of radiation controlled area: < 12.5μSv/h
- Dose rate at boundary of non-radiation controlled area: < 0.25 μSv/h
- Dose under operating operiod 25 μSv/h



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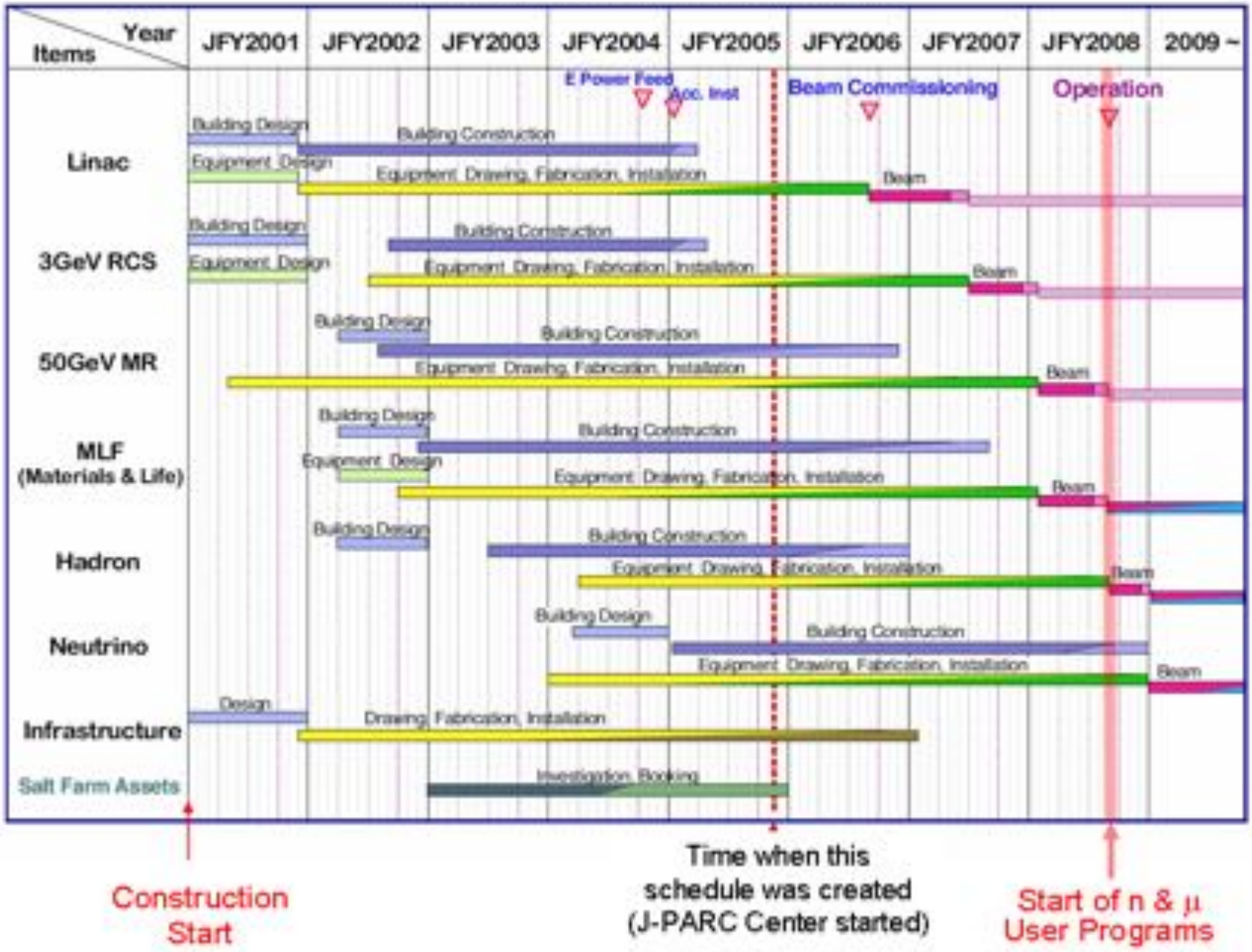
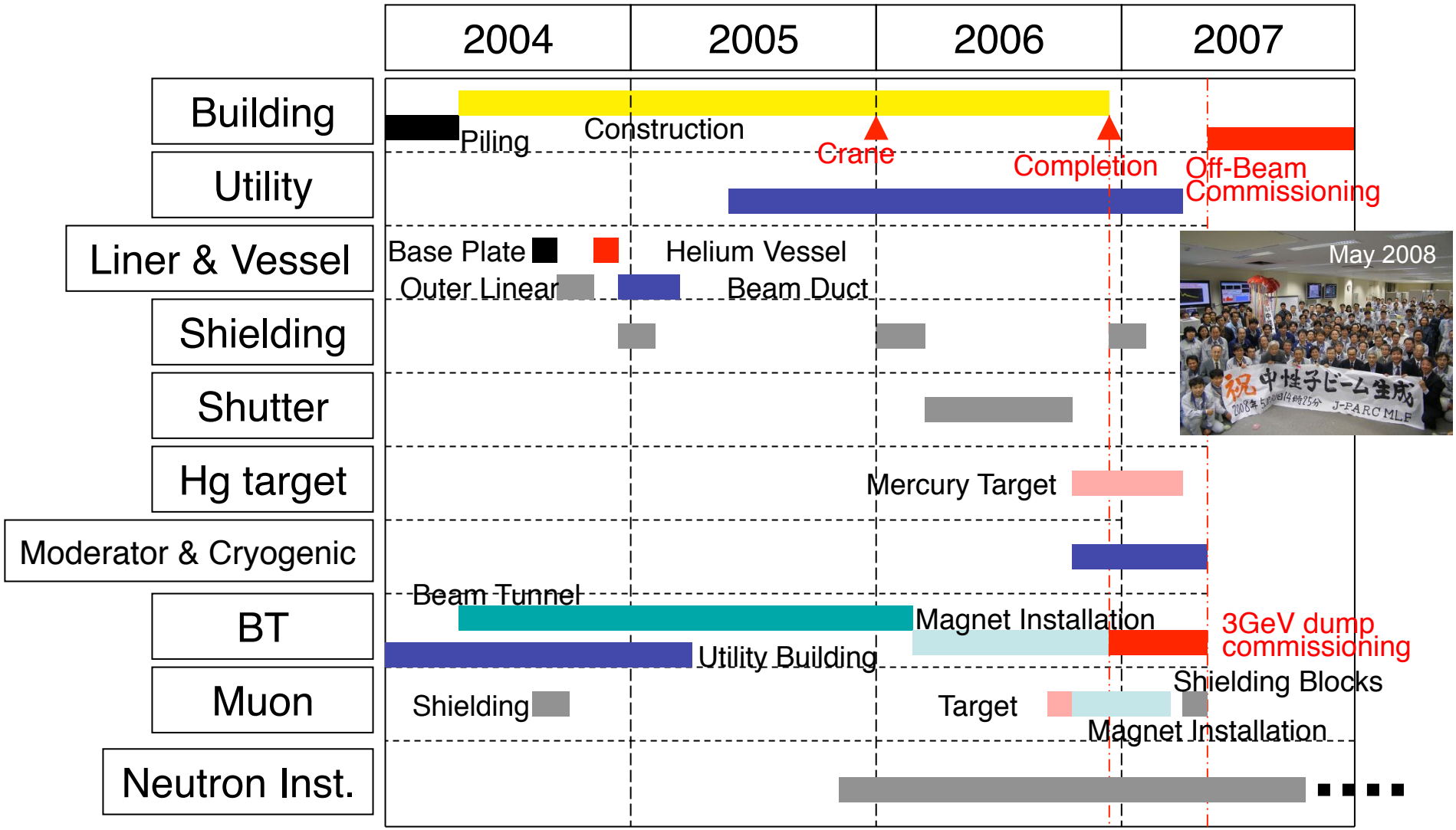
J-PARC Construction Schedule



Construction Schedule in MLF



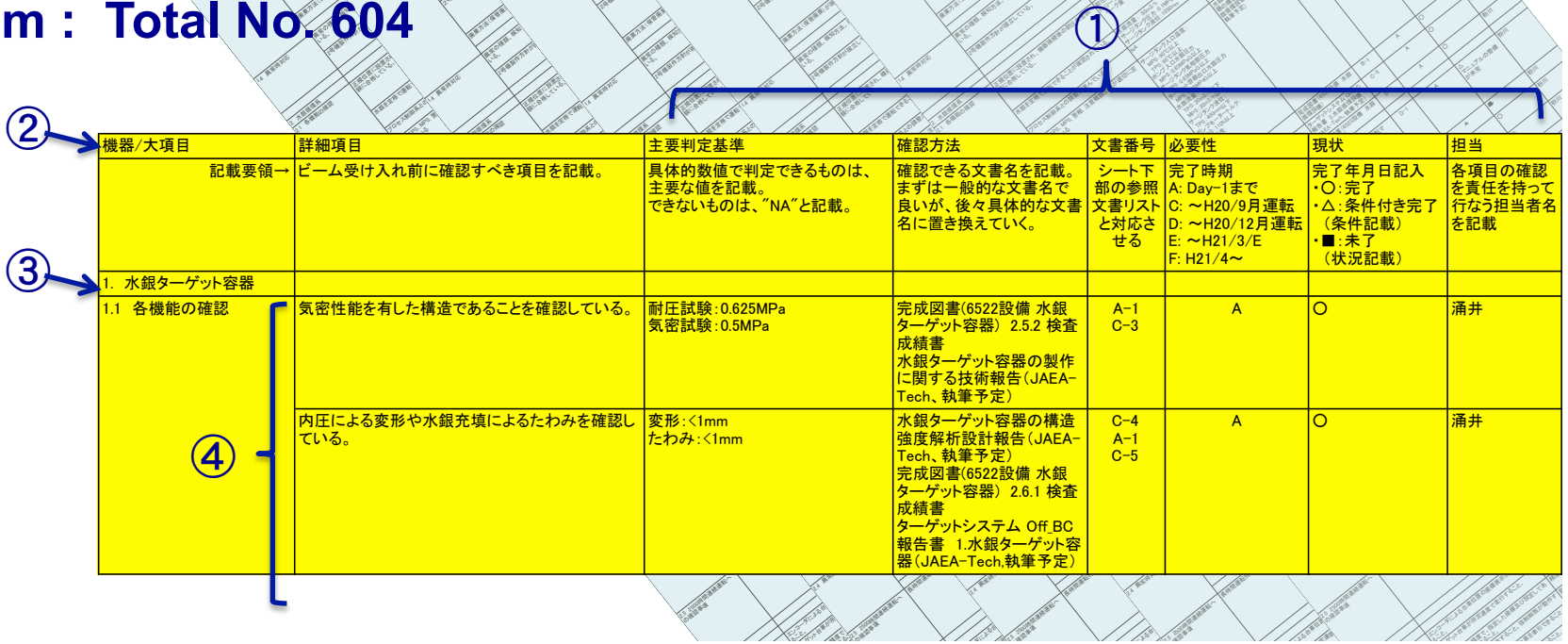
Readiness sheets
for the first beam and user operation

① Checking point: 6 points
Criterion for judgment, Confirmation method, Documentation, Until what time, Present status, Responsible person.

② Area: Total No. 20.
e.g. Building, Electric equipment, Mechanical equipment, Air conditioning, Manipulator, Target system, Moderator system, etc.

③ Components :Total No. 75

④ Item : Total No. 604



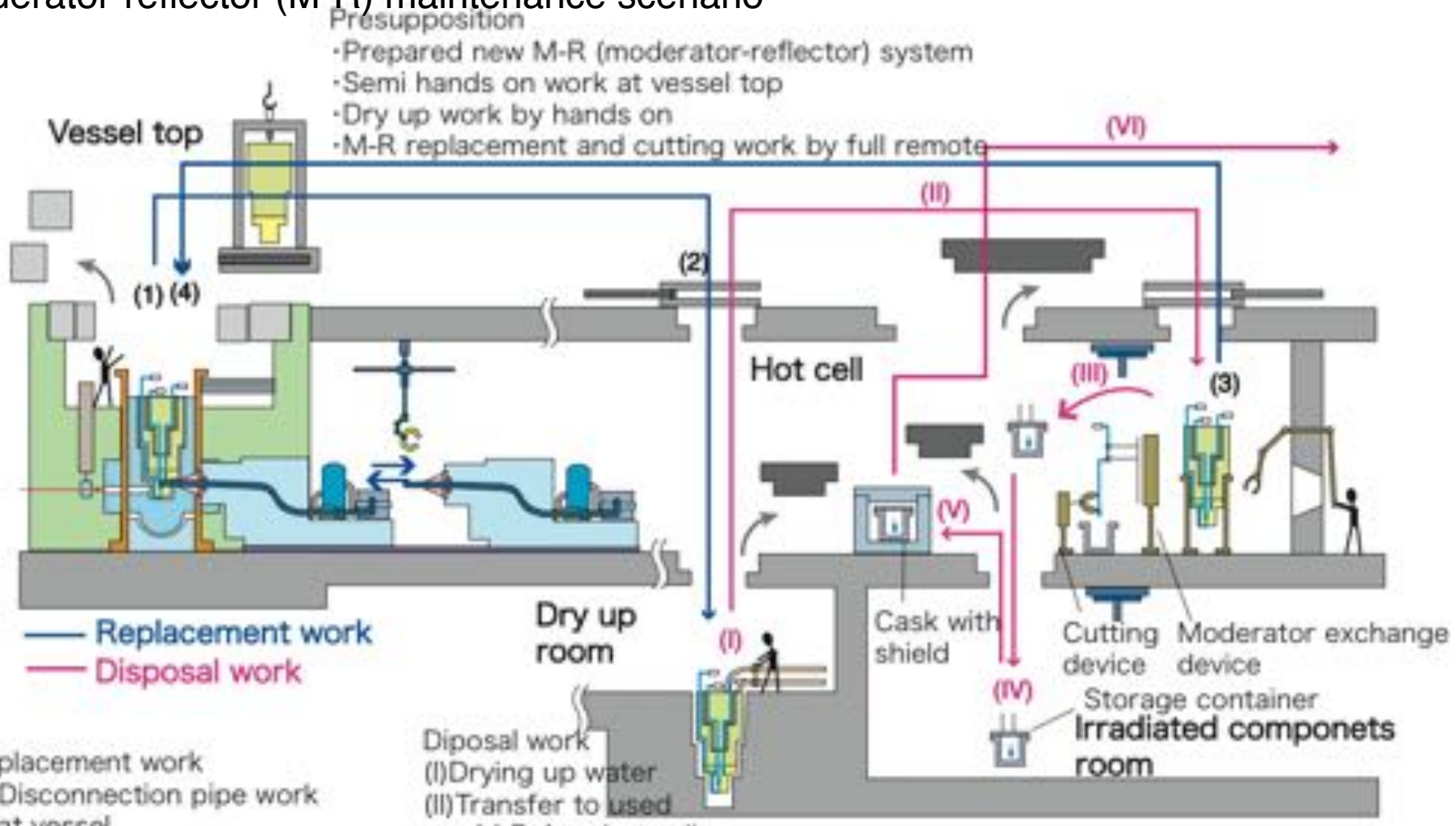
機器/大項目	詳細項目	主要判定基準	確認方法	文書番号	必要性	現状	担当
記載要領→	ビーム受け入れ前に確認すべき項目を記載。	具体的数値で判定できるものは、主要な値を記載。できないものは、"NA"と記載。	確認できる文書名を記載。まずは一般的な文書名で良いが、後々具体的な文書名に置き換えていく。	シート下部の参照文書リストと対応させる	完了時期 A: Day-1まで C: ～H20/9月運転 D: ～H20/12月運転 E: ～H21/3/E F: H21/4～	完了年月日記入 ・○:完了 ・△:条件付き完了（条件記載） ・■:未了（状況記載）	各項目の確認を責任を持って行なう担当者名を記載
1. 水銀ターゲット容器							
1.1 各機能の確認	気密性能を有した構造であることを確認している。	耐圧試験:0.625MPa 気密試験:0.5MPa	完成図書(6522設備 水銀ターゲット容器) 2.5.2 検査成績書 水銀ターゲット容器の製作に関する技術報告(JAEA-Tech、執筆予定)	A-1 C-3	A	○	涌井
	内圧による変形や水銀充填によるたわみを確認している。	変形:<1mm たわみ:<1mm	水銀ターゲット容器の構造強度解析設計報告(JAEA-Tech、執筆予定) 完成図書(6522設備 水銀ターゲット容器) 2.6.1 検査成績書 ターゲットシステム Off_BC報告書 1.水銀ターゲット容器(JAEA-Tech,執筆予定)	C-4 A-1 C-5	A	○	涌井

Check on replacement procedure according to readiness sheet

Requirements to satisfy maintenance scenario

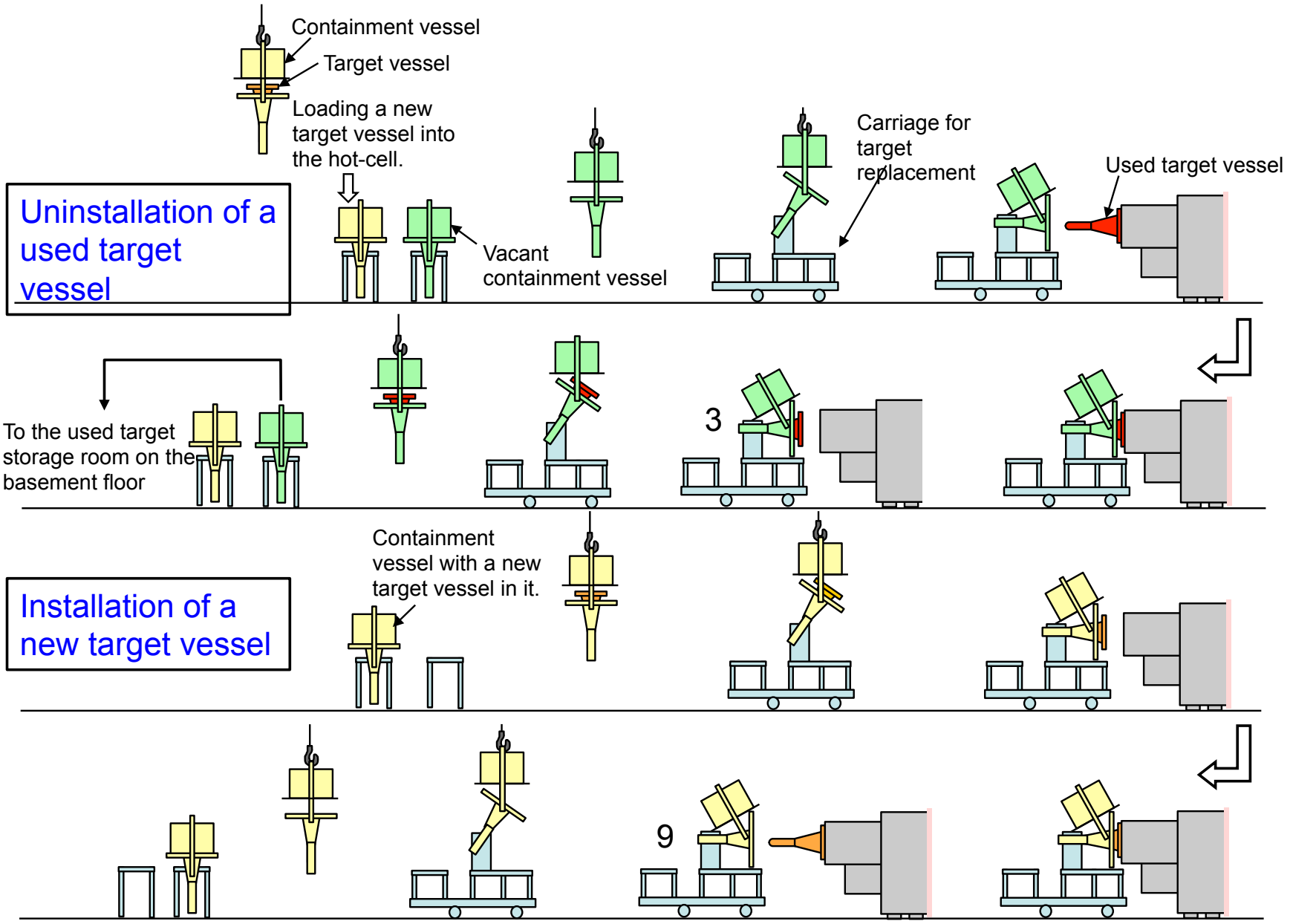
- Crane, Hatch, Floor load at High-bay etc. -

Moderator-reflector (M-R) maintenance scenario



Check on replacement procedure according to readiness sheet

Target Replacement Scenario



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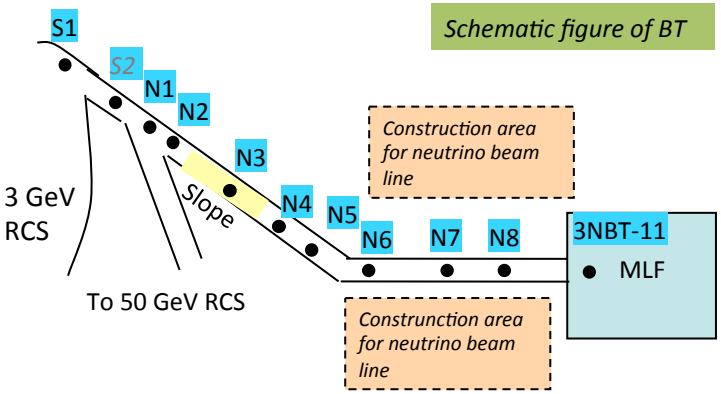
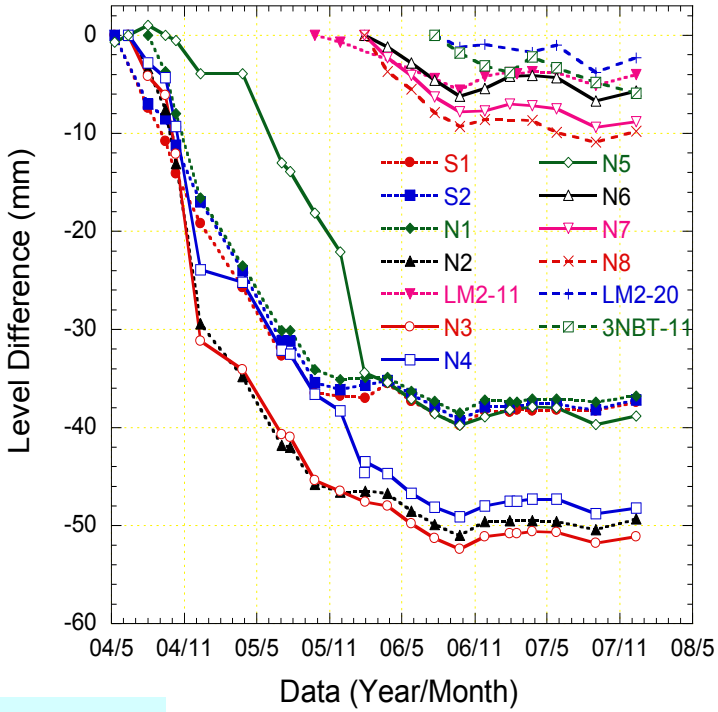
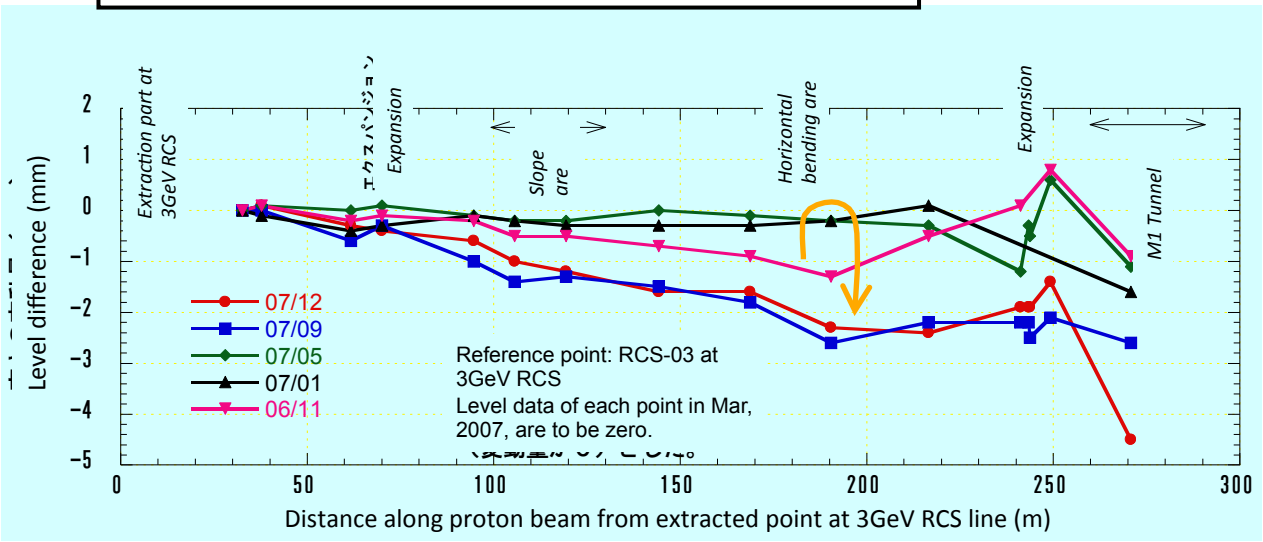
Results of settlement survey in 3NBT tunnel

Level survey in BT tunnel from RCS to MLF





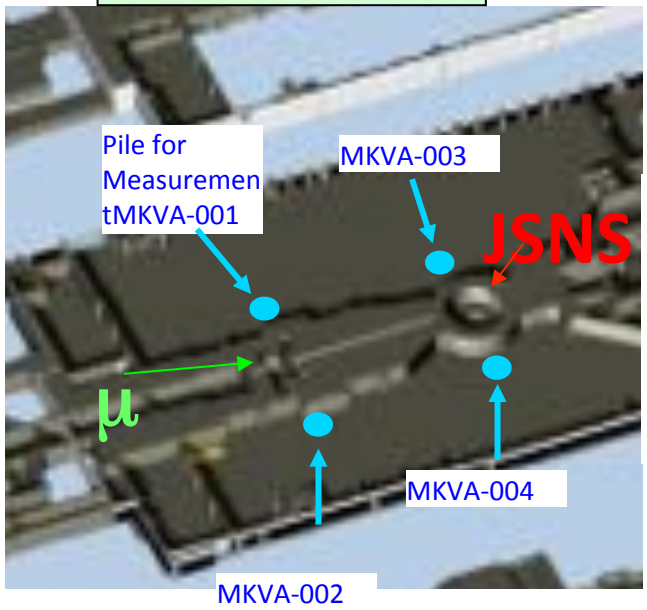
Result of the survey measurement (2)



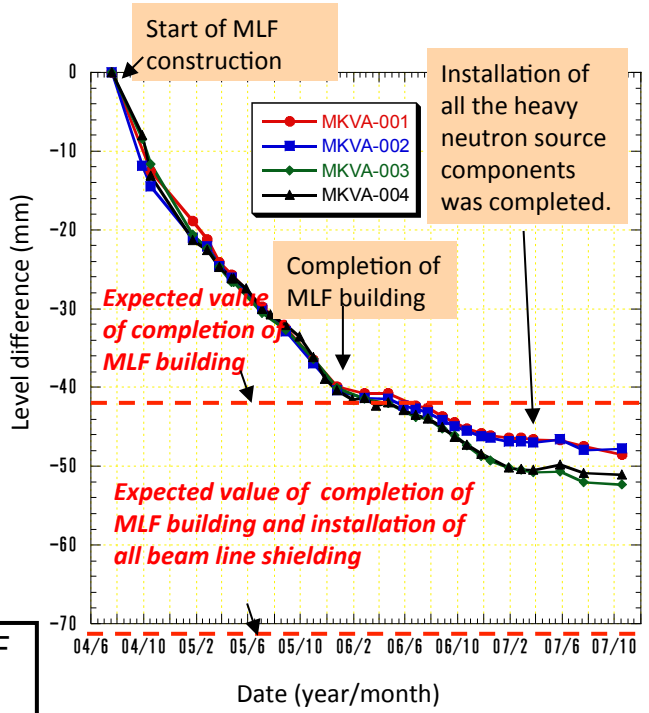
The 3NBT tunnel, especially at the downstream, floated until January 2007. Then, it sank unit December, 2007.
Even after the precise alignment in July, 2007, the downstream area in 3NBT slowly settles due to construction of neutrino beam line.
Realignment would be necessary.

Results of settlement survey in the MLF

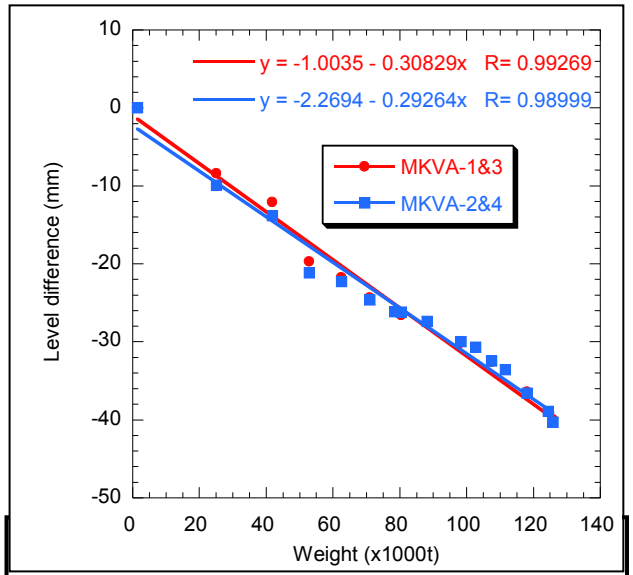
Position of piles for measurement

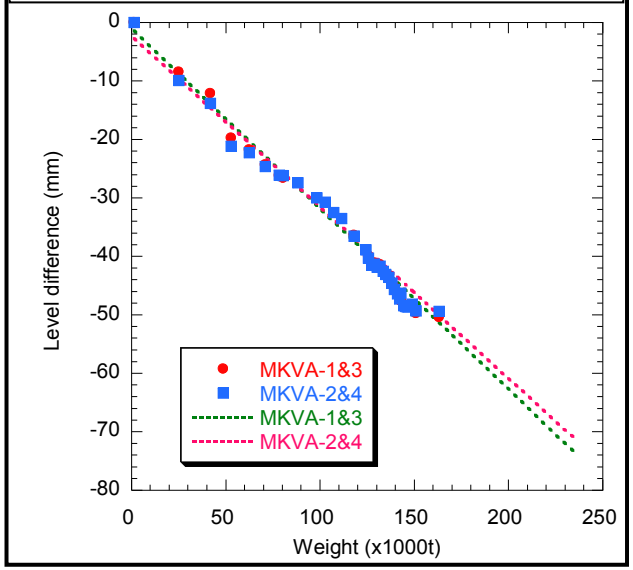


Measured result of Settlement



Relation of Settled value to Weight



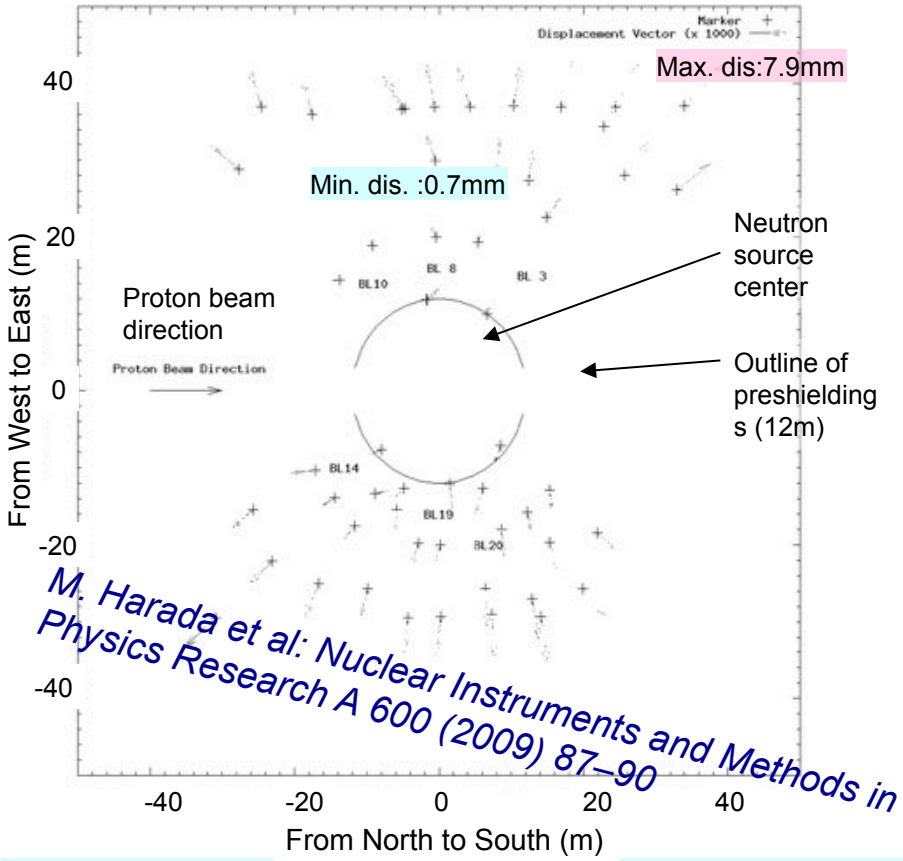


- The MLF settled quickly during the MLF construction.
- After the completion of the construction, it settled slowly.
- After the completion of the installation of all the heavy neutron source components, it didn't almost settle.

Settled values are proportional to weights located in the MLF building.
This proportional factor is about 0.3mm/1000t.
In the future, the MLF building will settle to be 70 mm at the installation of all the neutron beam components.

Horizontal and vertical displacement of the experimental hall floor concrete

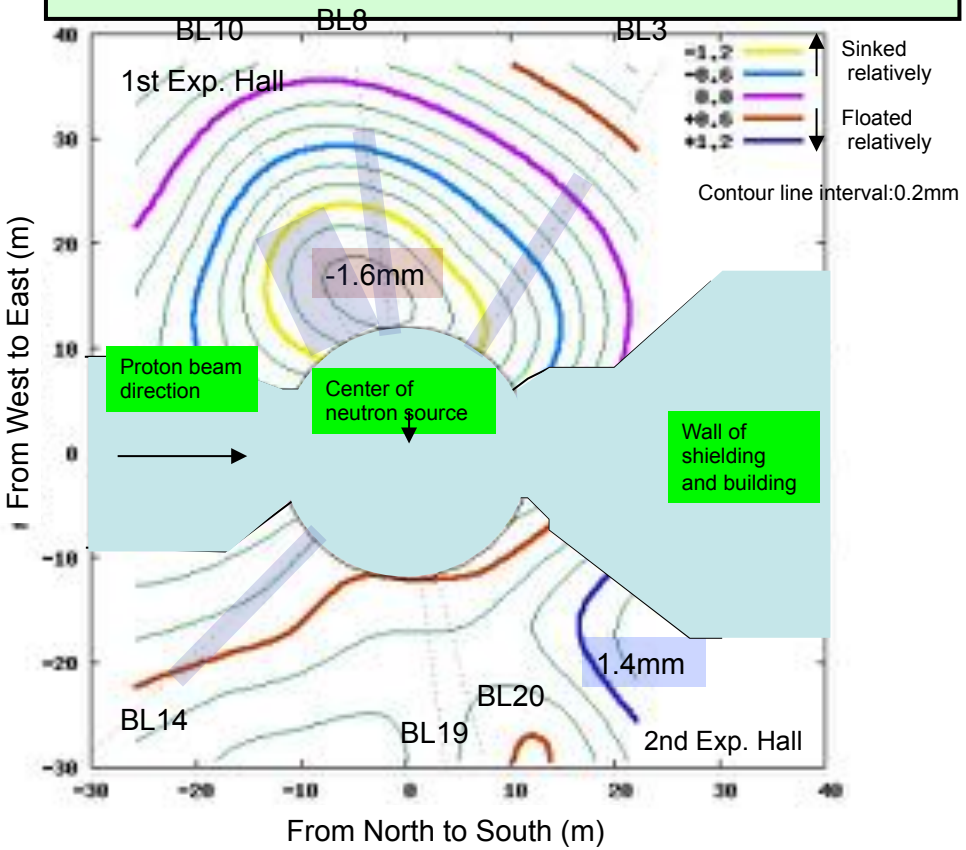
Horizontal displacement vectors of neutron beam line markers in the MLF experimental floor concrete



M. Harada et al: Nuclear Instruments and Methods in Physics Research A 600 (2009) 87–90

•Vector lengths were almost proportional to distances from neutron source center, it is thought that the concrete floor expanded thermally.

Uneven settlement of floor level in experimental hall in the period from Dec. 2006 to Oct, 2007



•1st experimental hall floor sinks to 1.6 mm at maximum and 2nd one floats to 1.4 mm at maximum compared to the average value. The reason is that beam line shieldings at BL3, BL8 and BL10 are installed.

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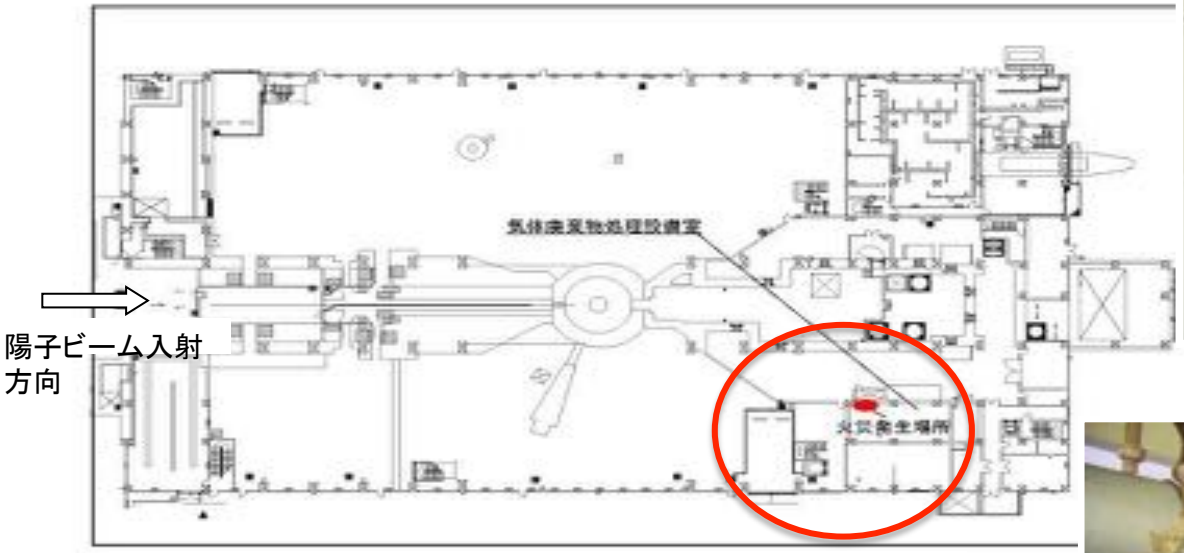
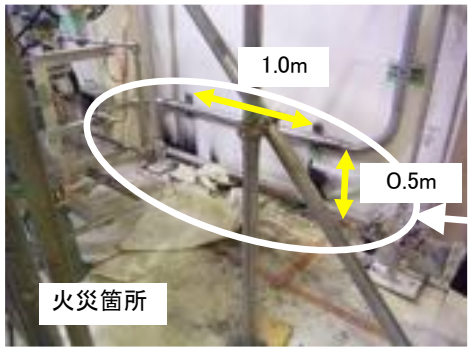
Location of Fire in MLF building during construction



MLF building 1st Floor



Welding on piping at MLF

- 知識に乏しい者がTIG溶接をした。
  - 板間の隙間大きく、溶接棒を渡す無理な溶接を行い、溶接棒の熔解物が下方に落下した。
- TIG溶接は安全と過信し十分な養生をしていなかった。
  - 作業者は、溶接火花が出ないので耐熱シートの養生シートなしで行えると思った。
- 持場を離れる時の火気確認が不十分であった。
  - 11時50分に溶接作業を終え、作業終了後の溶接作業に伴う安全確認を行わずに、12時に昼食のため現場を離れた。

溶接現場写真：現場溶接箇所には耐熱シート養生無し

Fire of normal sheet by welding drop

- 平成19年2月22日12時10分、本溶接に直接関係のない別件の作業者が、気体廃棄物処理設備室前を通行時、異臭を感じ火災を発見した。

- 壁貫通仕舞いのSUS板溶接現場の溶接後の残り火が、床養生に引火し、発煙した。

気体廃棄物処理設備室の火災現場写真

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Busy construction and very busy in crane schedule

✗ *No enough empty space for putting construction materials (shielding etc.)*

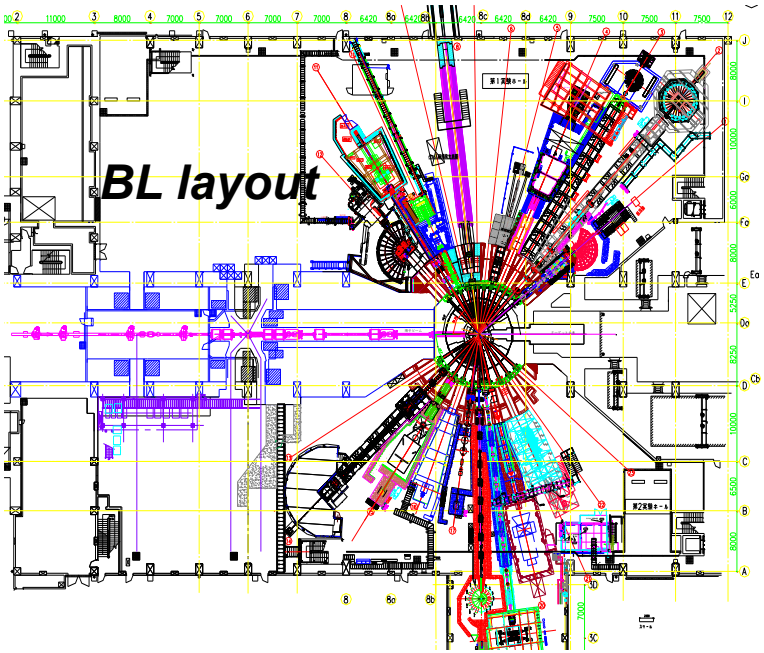
✗ *Construction period is very limited*

2008

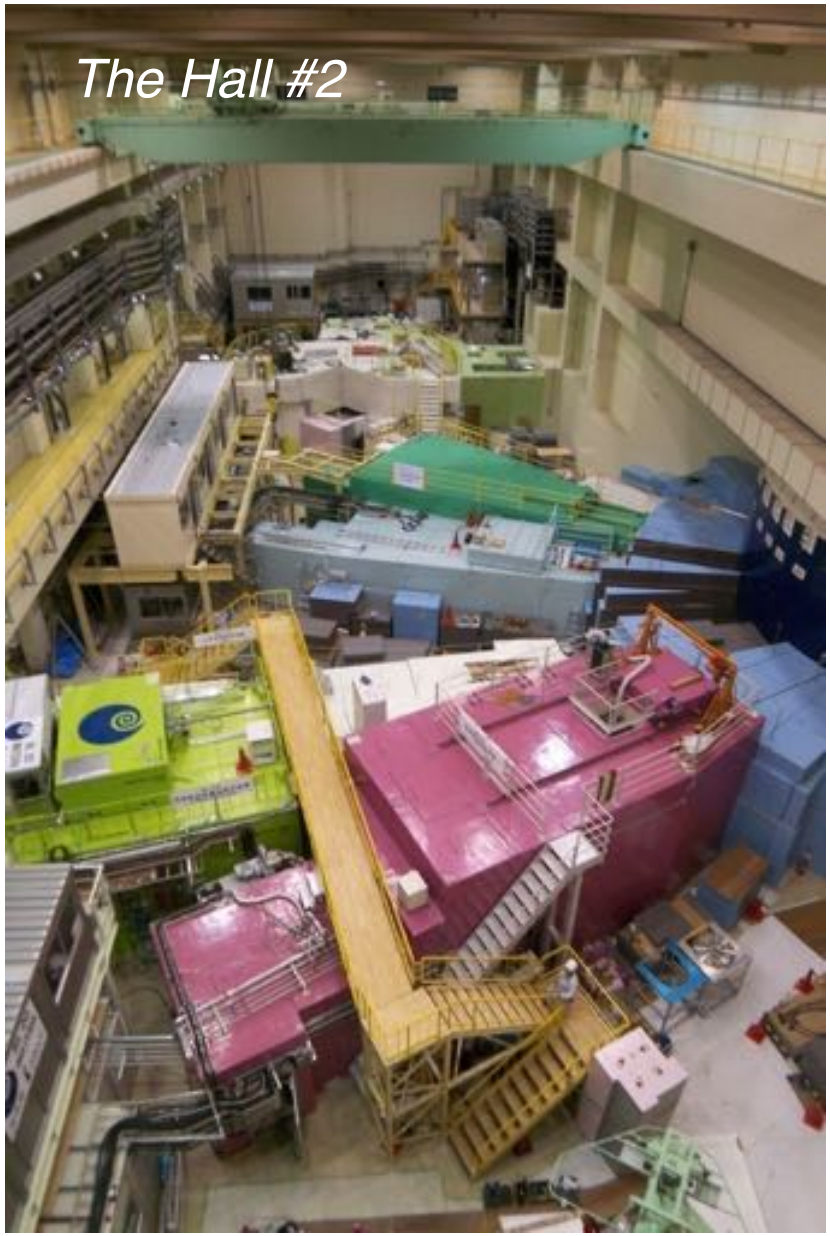
2009 2010

✗ *Construction in narrow area*

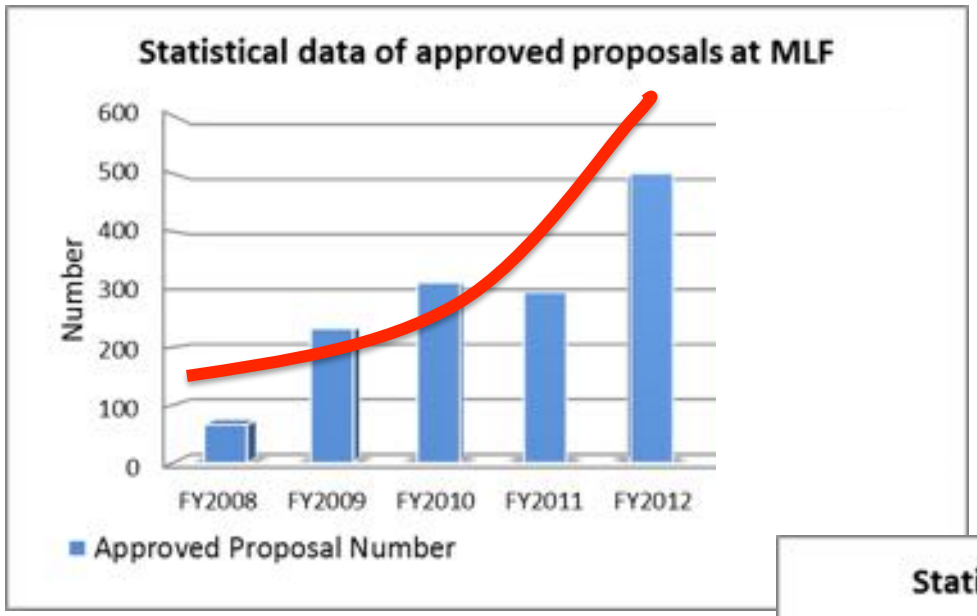
✗ *Very busy in crane schedules*



J-PARC MLF Experimental Hall (2011.1)

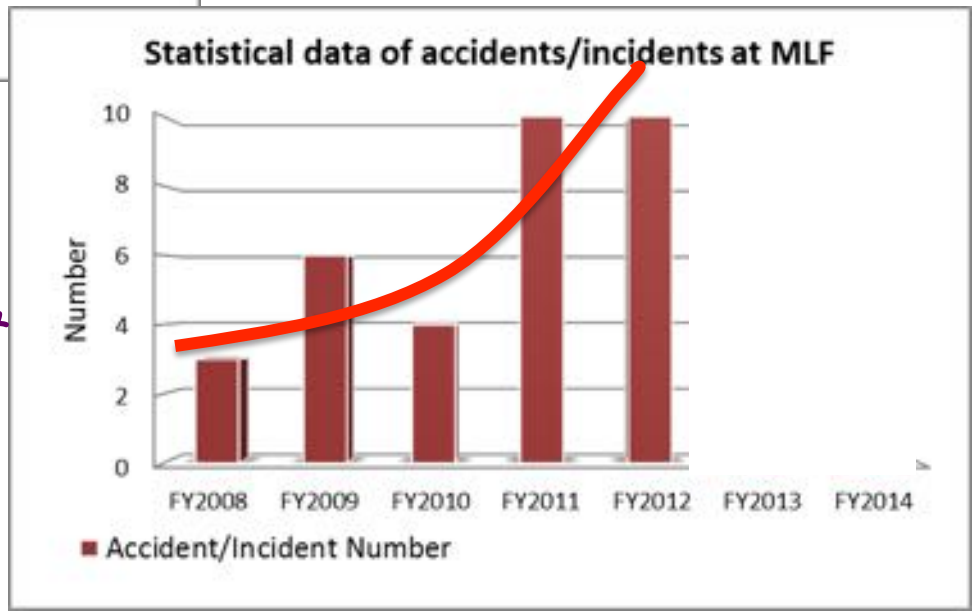


Statistical relation between proposal number and accident/incident number



Correlation between No. of Proposals and No. of accidents ?!

In the early stage period, most of the accidents are related to the neutron source, likely so-called early stage machine troubles.



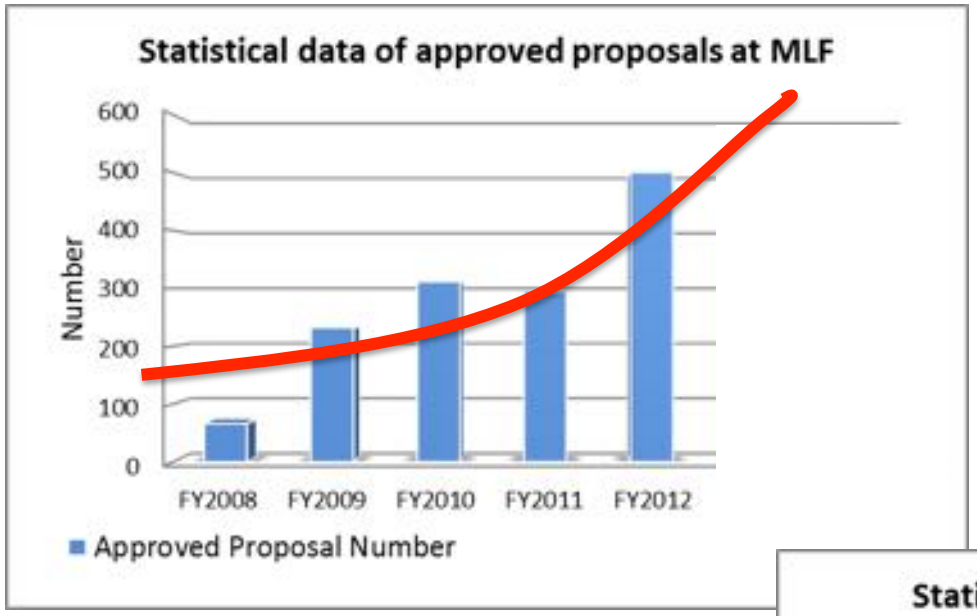
Accidents in experimental halls

Year	Date of occurrence	Incident	Injured person. / Radio. Leak.	Operational mode when incident occurred
FY 2007	20-Des	15t/5t crane, Wire rope rapture caused by incorrect 5t auxiliary crane operation to 8t shielding (BL20)	None	Maintenance
	22-Feb	7.5t Crane, Front Beam contact on wall (Experimental hall 2, Stairs wall)	None	Maintenance
	4-Mar	7.5t crane, Contact on the wall (Experimental hall 1, Stairs wall)	None	Maintenance
	6-Mar	7.5t, Scaffold on the crane girder contact air duct (Experimental hall 2)	None	Maintenance
	11-Mar	7.5t crane, Contact handrail on catwalk (Carry-in entrance at Experimental hall 2)	None	Maintenance
	25-Mar	30t crane, irregular winding caused by operation shaking hook when it is returned to the normal position. (BL14)	None	Maintenance
FY 2008		7.5t crane, Suspended load fall	None	Maintenance
	27-Jan	Hand, Laceration (Experiment preparation room 2)	Injured	User program
FY 2009	24-Jan	Sample broken by high magnetic field, inappropriate treatment (BL10)	None	User program
	31-Jan	PPS Alarm, failure (BL19)	None	User program
	16-Apr	Knee, Bleeding (Floor under vacuum chamber at BL01)	Injured	Maintenance
	5-Mar	Shin, bleeding (Front shielding of BL11)	Injured	Maintenance

Year	Date of occurrence	Incident	Injured person. / Radio. Leak.	Operational mode when incident occurred
FY 2010	14-Jul	Extension cable, short (BL02)	None	Maintenance
	13-Sep	Sample holder broken, Al hydride scatter in storage locker (BL21)	None	User program
	11-Mar 2011 EQ	Shielding (LiH) container broken and scatter (BL04)	None	Maintenance
FY 2011	12-Jul	15t/5t crane, Chain block break damage due to incipient failure (BL18)	None	Maintenance
	20-Jul	Staff, 50t crane, Suspended load contact on BL21 sheilding, Incorect setup. (Beamline shielding of BL20)	None	Maintenance
	30-Aug	50t crane, Shielding damage, Incorrect operation to bolted shielding (BL11)	None	Maintenance
	16-Sep	Lumbar, bone-fracture (Beamline shielding of BL19)	Injured	Maintenance
	5-Oct	7.5t crane, Contact on the wall (BL02)	None	Maintenance
FY 2012		Hand bleeding (BL21)	Injured	Maintenance
	27-Nov	Ejection of center stick of cryostat at BL14	None	User program
	5-Dec	Melting V beam window of furnace at BL20	None	User program
	10-Feb	Power strip, sandwiched between hatch and shielding (BL01)	None	User program
	6-Mar	Sample can damage at BL02	None	User program
	8-Mar	Sample splashing in SnI4 melting experiment at BL21	None	User program

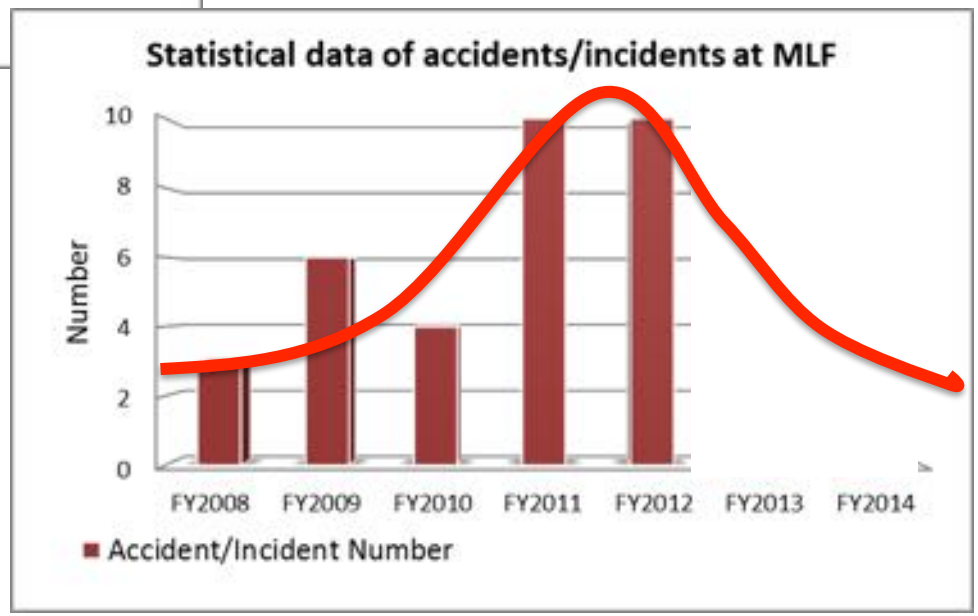
Safety education & Training

Statistical relation between proposal number and accident/incident number



Correlation between No. of Proposals and No. of accidents ?!

Good !



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Interface, Communication, Responsibility

Construction Department ⟷ **Interface** ⟷ **Materials & Life Science Experimental Facility Group**

- **Responsibility** for building design and construction

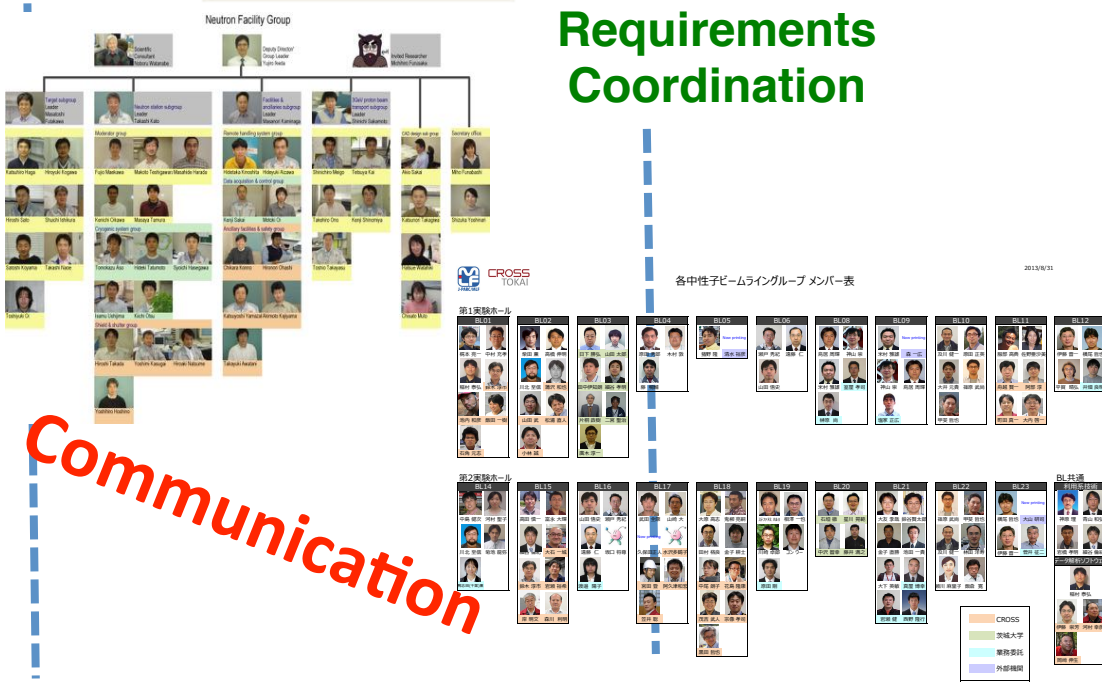
Requirements Coordination

- **Responsibility** for source components and instruments construction

Neutron Source Design Core ⟷ **Interface** ⟷ **Instruments**

Requirements Coordination

- Width and height of building
- Load distribution on floor
- Pit location of neutron instruments
- Future expandability of instruments
- Beam design on the wall structure
- Embedded items
- Construction seqence



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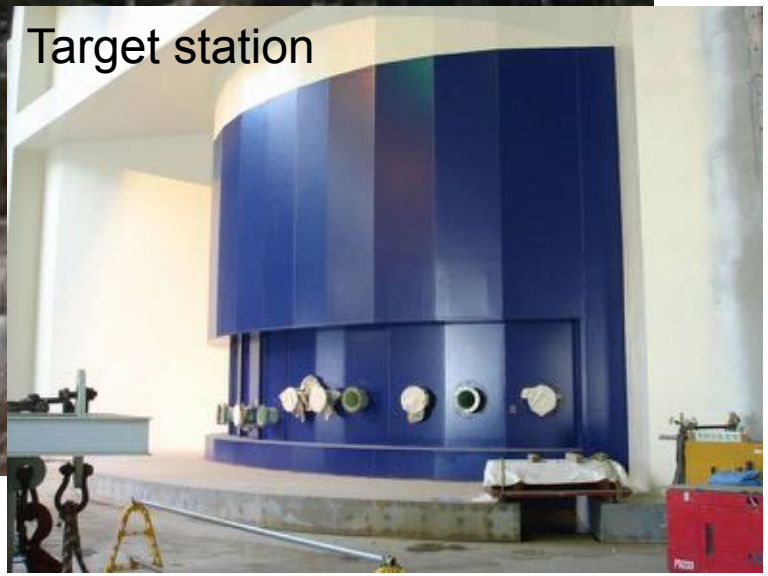
ヘリウムベッセル
2004年10月17日


アウターライナーを囲むSC壁
2004年12月16日


2005年11月30日


沈下測量作業
2005年4月23日

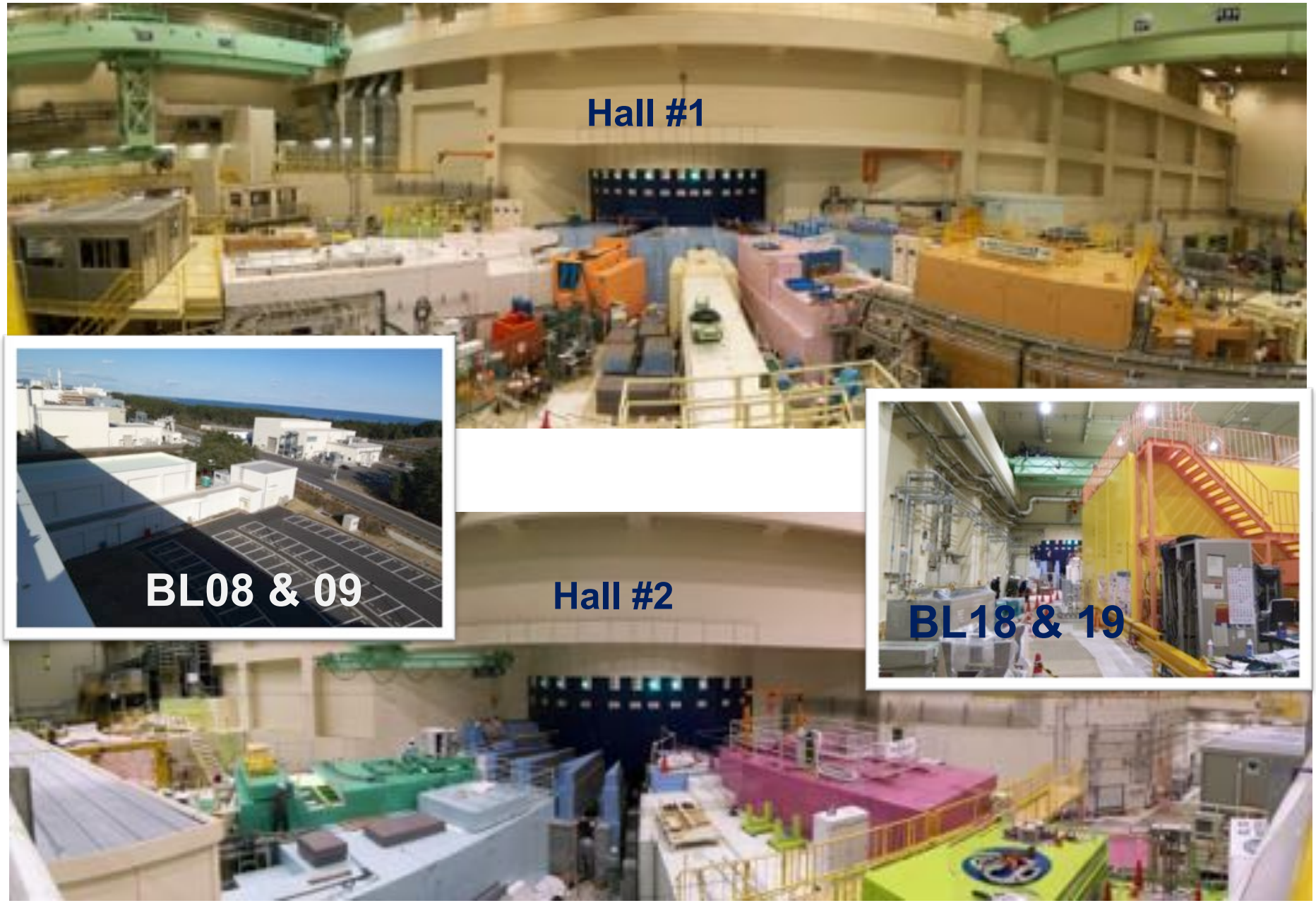
2006 Materials Life science Facility (MLF,JSNS) building in 2006



Target station


04
05
06
07
08
09
10
11
12
特性試験装置コリメーター設置
2007年3月15日

View in MLF 2011 Jan 7 (9 inst. oper. + 6 under const.)



Summary

- **Safety !**
- **Communication !**

  In particular relating to interface among components.
- **Responsibility !**

  Who is a person for each component and structure.
- **Special items to take care !**

Ground subsidence
Cran accidents
Fire, etc.