The 2nd International Forum on the Decommissioning of the Fukushima Daiichi Nuclear Power Station

Lecture and Mini-Workshop "What could we know more about 1F NOW!"

2017.07.02

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For the real Sharing of the D&D Situation

- **From <u>"D&D Implementer =>Local People"</u>**
  to <u>"Local People=>D&D Implementer"</u>

○ Intensive Prior Interviews with local People while local People poses Questions directly

- Pre-Research with local people on their concerns, questions, suspicions etc.
- Meetings with 5 Groups living at Fukushima + Interviews with 5 Figures known locally

=> Booklet **"Voice from Fukushima"**

- **Mini Workshop** among the Participants
  =><u>Today after this Lecture</u>

- **All the Concerns, Dissatisfactions, Questions, Wishes etc. being sorted out and Research Session (Local People will research)**
  =>Scheduled this afternoon
  Questions to be directly addressed to Representative, METI, NDF, TEPCO with definite Responsibility on the Stage

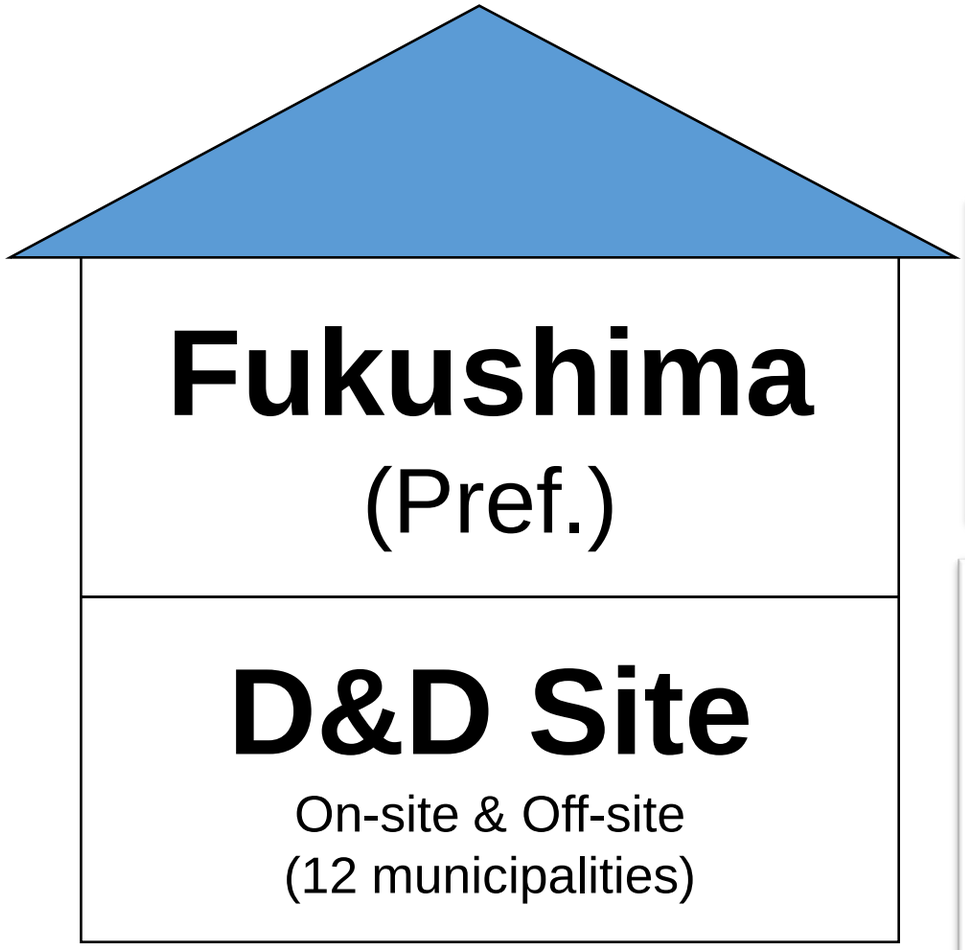
- （More detail information to be provided at the 2nd day session of this Forum）

Brief Introduction of 1F D&D Situation

Now start Main Topics of Today!

Structure of Fukushima Issue

- **“Fukushima Issue”?**
- **Two storied Structure**
  - **Fukushima=Well visible from the distance**
  - **D&D Site=Visible only by coming closer**
  - **Collapse of 1st Floor leads to Collapse of 2nd Fllor**
  - **Stable 1st Floor assures 2nd Floor**
- **Mixture results in enlarged secondary damages**
  - **“Everywhere in Fukushima is contaminated”**
- **Direct Image at the time of Accidents externally imprinted**
  - **More Routine of 2nd Floor, Erosion of “Reconstruction”**
  - **Start to launch on 1st Floor?**
- **Then, what are the issues of 1st Floor = D&D site?**



What is an Issue of D&D?

Critical Difficulty =>

<u>"We don't know what is unknown"</u>

- **Is it "Contaminated Water", "Dose rate to the labor", "Fuel debris (molten fuel) ・・・・・?**

- **Fundamental question relative to 1F D&D is;**

<u>Nature of "Unknown unknowns"</u>

Two Unknowns

1) <u>Inside of Reactors</u>＝No definite Information yet

2) Ourselves＝Not knowing yet what to know

- Through Pre-Research; “Beyond understanding”, “No understanding on public outreach materials”, No idea what goes on and what will come next”, “No understanding even on languages”
- Despite no idea what is done for what, media delivers news of “incidents or troubles”. This is the source of concerns, dissatisfaction, questions etc.
- Focal point now is; moving from on-site to off-site, from “science and mathematics” to “social issue and liberal arts” by lifting of evacuation order and/or increase of waste

= Local people should take a lead in decision by knowing more.

- **Target of Today’ Forum: “To solve the Difficulties of Unknown Unknowns” relative to 1F D&D**

Let’s start with Fukushima Pref.

Q1. How much out-flow of evacuated People? How many %?

Out of the people living in Fukushima Pref. before 3.11, how many people are forced to evacuate out of Fukushima Pre.?

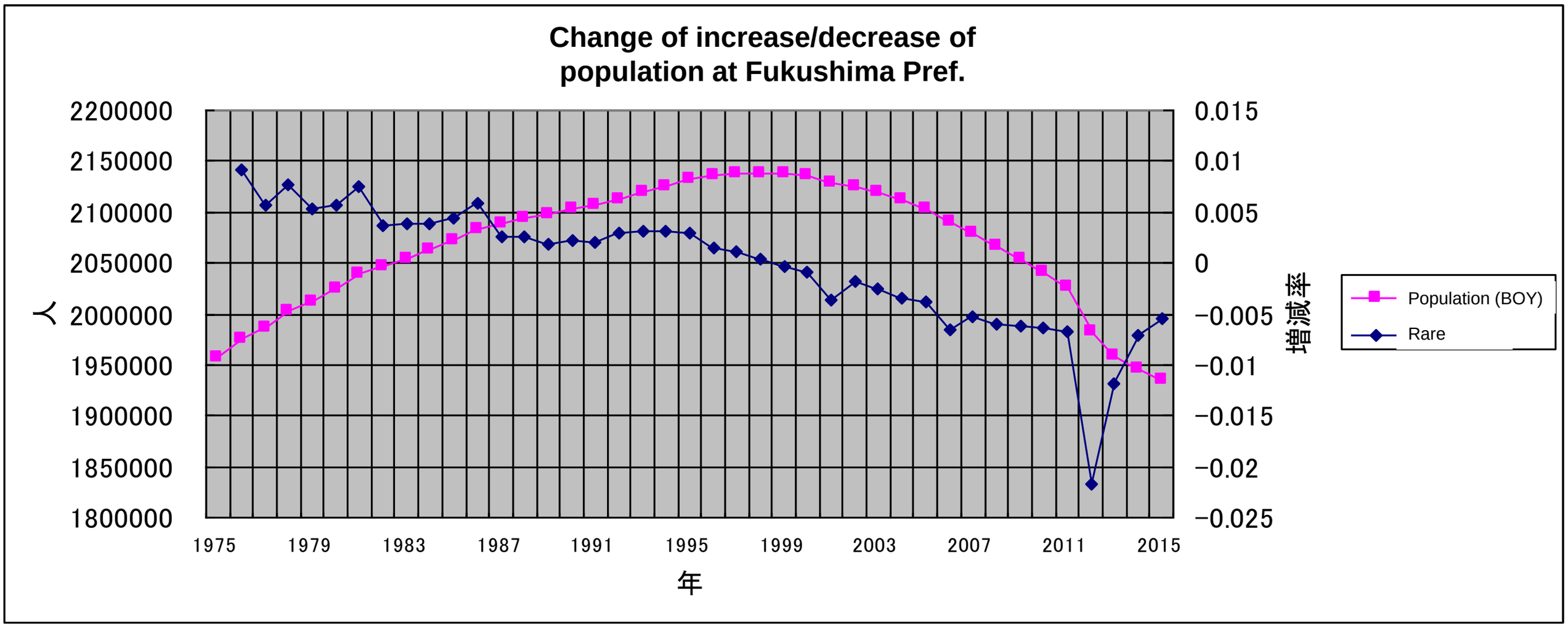
1.7%

- 2.024 Million People（2011/3/1）
- 35 Thousands People（2017/1/16）

- **Change of Population : same as before 3.11**

Uneven Concentration of People:

Iwaki, Koriyama etc. with land price rise



Q2. Change of Rice Yield?

Ranking among all Japanese Prefectures and recent Recovery

No.4 in 2010

→No.7 in 2011

（rice acreage：ha）

2010　80600

2011　64400

2012　66200

2013　68200

2014　68200

2015　65600

2016　64200

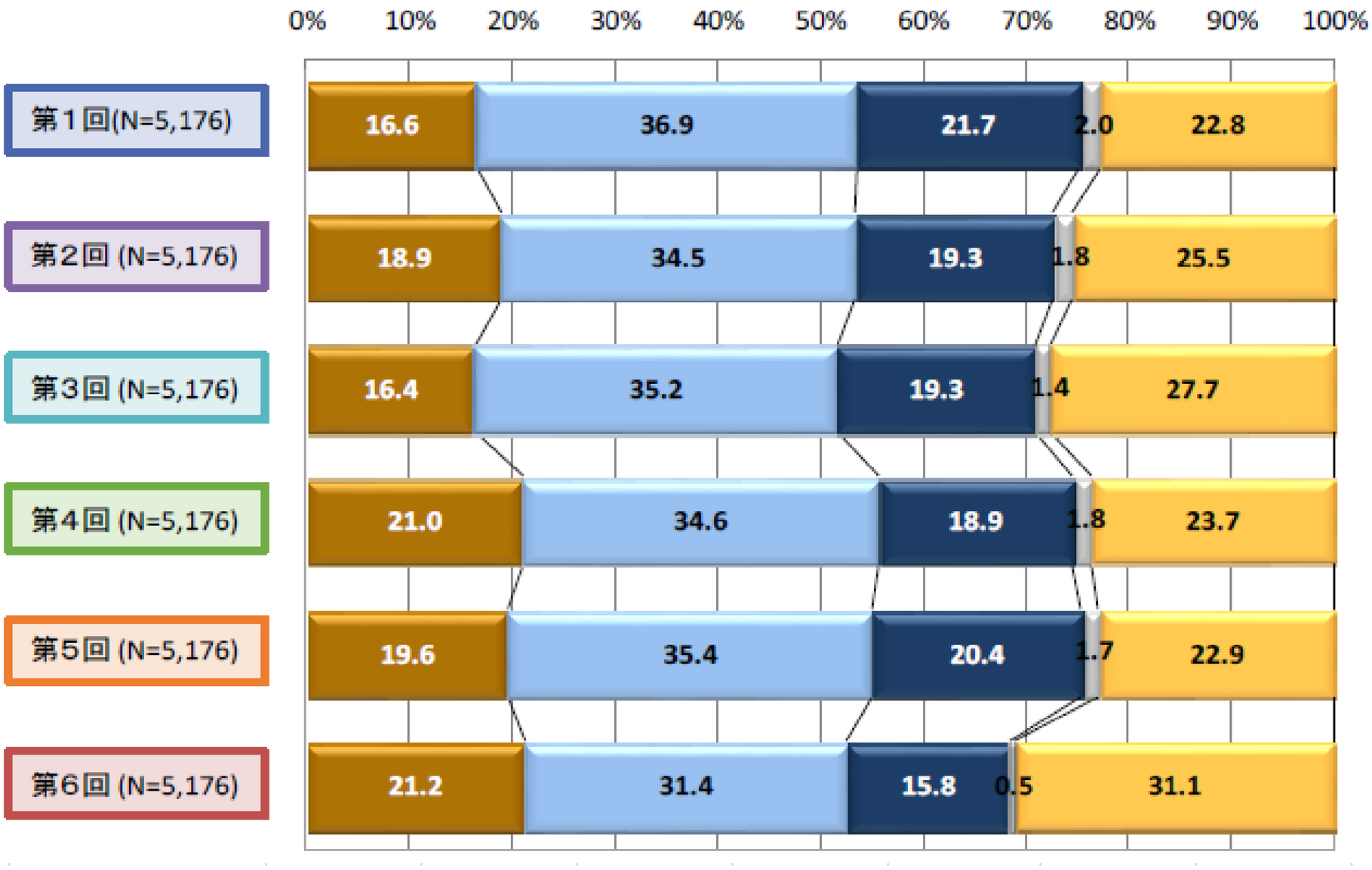
Q3. How many rice bags exceed regal limit (100 Bq/kg) after all bag inspection over 10M bags in a year?

2016: 0 bags

- 2012 : 71
- 2013: 28
- 2014: 2
- 2015: 0

・Do you accept the low risk which cannot be confirmed to affect the health due to the irradiation?

- ・Not accept worrying about increase risk of cancer though within the limit
- ・Accept due to lower risk in comparison with other cancer (smoking, heavy drinks etc.)
- ・No concern since even non-radioactive materials could cause cancer
- ・Others
- ・No chance to access risk due to limited information



Q4. How much amount of landing recovered? (2015)

- **Territorial 22%**
- **Common in Gross 60.7% (2016)**

2015: Territorial 15.5%, Common in Gross 57.5%

2014: Territorial 14.6%, Common in Gross 75.9%

2013: Territorial 8.9%, Common in Gross 57.2%

- Landing at Fukushima Prof; Territorial
- Business entities at Fukushima Prof; Common in Gross

Cs Monitor (over100bq/kg)

2015: 4 samples out of 8577 exceeded

(180 kinds of fish)

（Tomioka Rockfish 3, Iwaki Stone Flounder 1)

2011：785 out of 1972=>2012：921 out of 5580

=>2013：280 out of 7641=>2014: 75 out of 8722

- **Nearly no discharge of radioactive materials**
- **Too limited selection of fish kinds**
- **Change of Fish Generation: Decrease of Fish living in 2011 Spring**
- **Half life: Cs 134 2Years**

Q7. How much of recovery (2015)?

87.9%

(2014: 82%)

2013: 84.5%

- School Excursion (Educational tour by school)
- Foreigners

Challenges for Fukushima

1. **Generic Issues to Whole of Japan**
   Declining Birthrate and Aging Population、Medical Welfare、Decaying of existing Industry
2. **Challenges at the time of post-Recovery**
   Civil Construction Industry, Medical Welfare Services etc.
3. **Reputational Damage**
   Economic Damage, False Information,Biased Rumor
4. **Reconstruction of 1F Site Periphery**
   12 Municipalities, Life of 30,000 People
5. **Social Consensus Making**
   Contaminated Water, Decontamination of Debris, 1F D&D･･･

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NEXT

Situation of 1F D&D

Time

Q1. How much Time will be needed until the Completion of 1F D&D?

25-35 Years

Current Schedule;
2041-2051 to be completed

What are needed to meet this Schedule?

Three Major technical Challenges to be overcome individually

Three Major technical Challenges for 1F D&D

(1) Contaminated Water

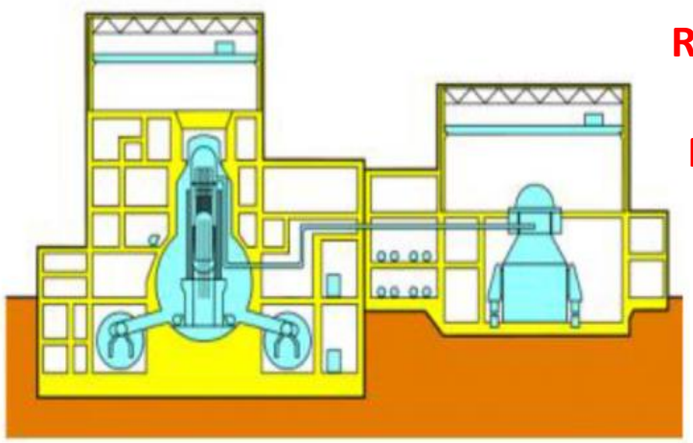
(2) Fuel Retrieval/Removal

2 kinds of Fuel Storage in the Reactor; "Pool" and "Pressure Cooker"

- **Spent Fuel, intact: @Poor**
- **Fuel Debris, molten: @Pressure Cooker**

(3) Dismantling and Disposal (D&D)

"Normal Reactor" D&D (3) only



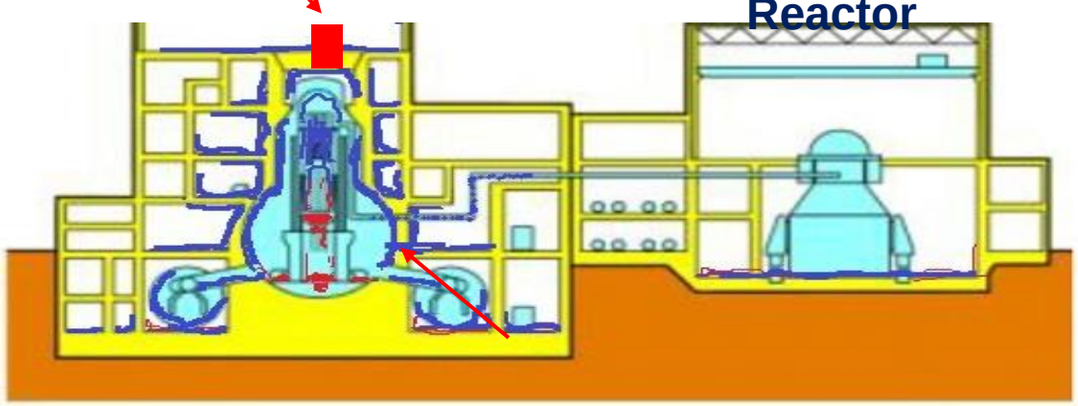
Removal of Nuclear Materials

"Accident Reactor" D&D All of (1) to (3)

Difficult to remove not only SF but also damaged Fuels

Difficult Access to Fuel

Radioactive Cs scattered in Reactor



Fuel Debris scattered

• Road Map 2011/12

- **1st Period; Preparation for SF Removal from the Pool→*Within 2 Years***
- **2nd Period; Preparation of Fuel Debris Retrieval Within 10 Years**
- **3rd Period: Completion of D&D →30-40 Years**

Challenge:

•How successfully Contaminated Water and Fuel Debris could be dealt with in the future?

Q2. How much Underwater flew into Unit 1-4 of 1F Reactor Building of in a day before the completion of Frozen Soil Wall (Ice Wall)?

130-140 m³/day (2017/5)

One Loop
Three Wells
Two Walls

図解 汚染水対策

海抜 35m

1号機 原子炉建屋

1号機 タービン建屋

2号機 原子炉建屋

2号機 タービン建屋

海抜 10m

海抜 4m

防波堤

上部透水層

地下水位

地下水バイパス

もともと1Fは山から海へと地下水が流れる場所にあった。そのため「サブドレン」と呼ばれる井戸を掘って地下水を汲み上げて抜いていた。それが津波で壊れてしまい、建屋周辺に地下水が大量に流れ込んでしまった。

そこで新たに「地下水バイパス」を作り、使えるサブドレンも利用して地下水を汲み上げている。さらに陸側からの地下水の流入を防ぐために作られたのが「陸側遮水壁」。これらが汚染水を増やさないための取り組みだ。

陸側遮水壁

サブドレン

難透水層

下部透水層

難透水層

地震や水素爆発で建屋地下のケーブルや配管を通す貫通部が壊れてしまい、そこから建屋に地下水が流入、建屋内の水やデブリなどの汚染源にふれて汚染水となってしまう。

トレンチ

地下水ドレン

建屋周辺地下水

ウェルポイント

ボーリング孔

陸側遮水壁

建屋に入らず海側にまわりこみ、遮水壁でせき止められた地下水は、「地下水ドレン」と「ウェルポイント」と呼ばれる井戸で汲み上げられてタービン建屋にもどされている。

Q3. How much Bq/1L of the highest Level of Cs 137 is contained at the Harbor near Unit 1-4?

1.2 Bq/L

(2017.06.12 official data)

Regal Limit on Radioactive Cs in Foods

Kind		Limit by Ministry of Health and Welfare (Bq/Kg)		EU	USA
		Temporary until 2012.03	After 2012.04		
Radioactive Cs	Drinking Water	200	10	1,000	1,200
	Milk and Milk Product		Milk 50 Baby Food 50	400 (Baby)	
	Vegetable	500	100	1,250	
	Grains				
	Meat, Egg, Fish, etc.				

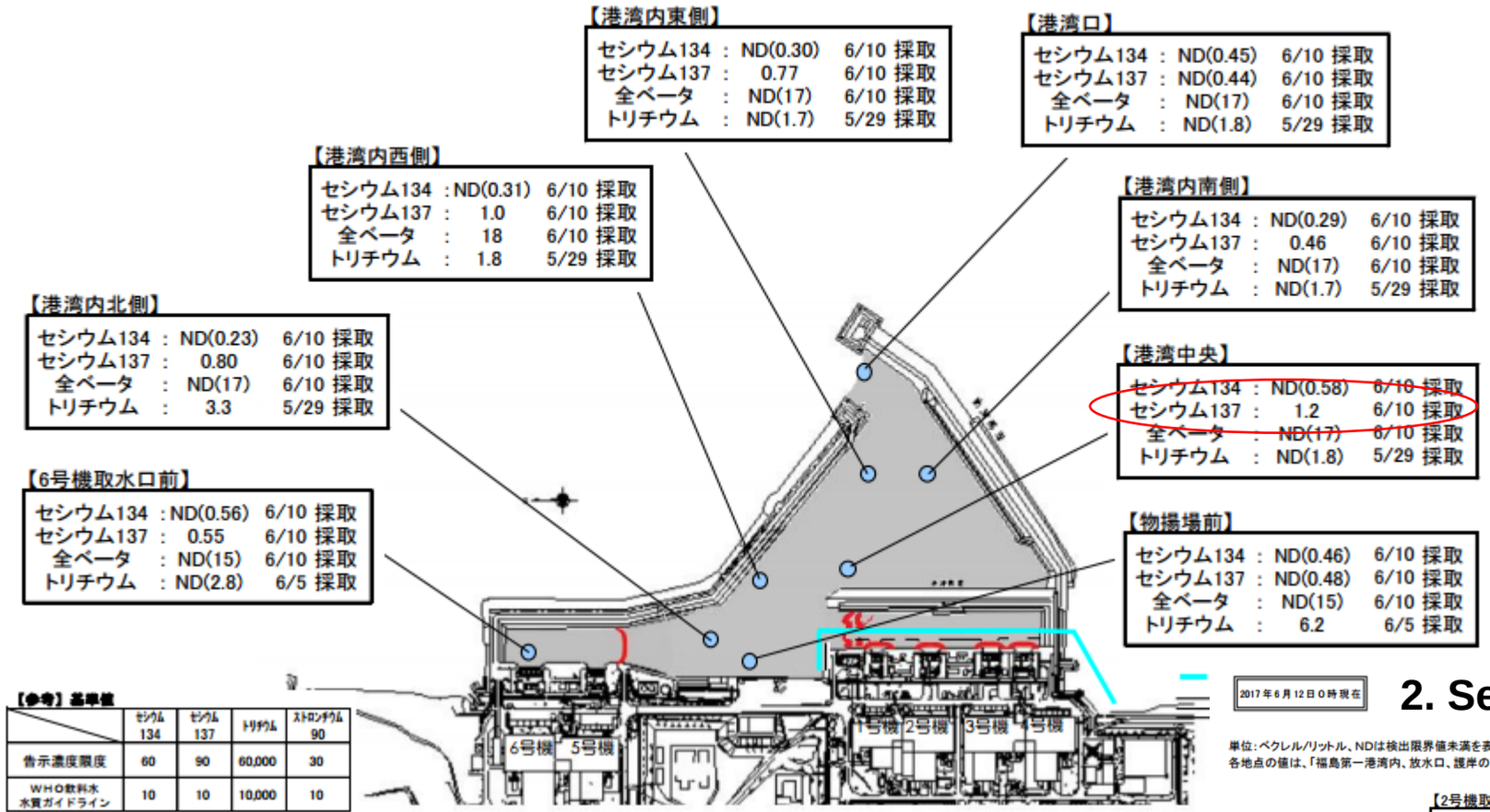
http://www.kantei.go.jp/saigai/pdf/g31_siryou2.pdf

2017年6月12日0時現在

2. Sea water analysis data (1F Harbor inside)

2017.06.12 TEPCO Holding Co.

Unit: Bq/L, ND: Not Detectable
( ): Detectable Limit



【参考】基準値

	セシウム134	セシウム137	トリチウム	ストロンチウム90
告示濃度限度	60	90	60,000	30
WHO飲料水水質ガイドライン	10	10	10,000	10

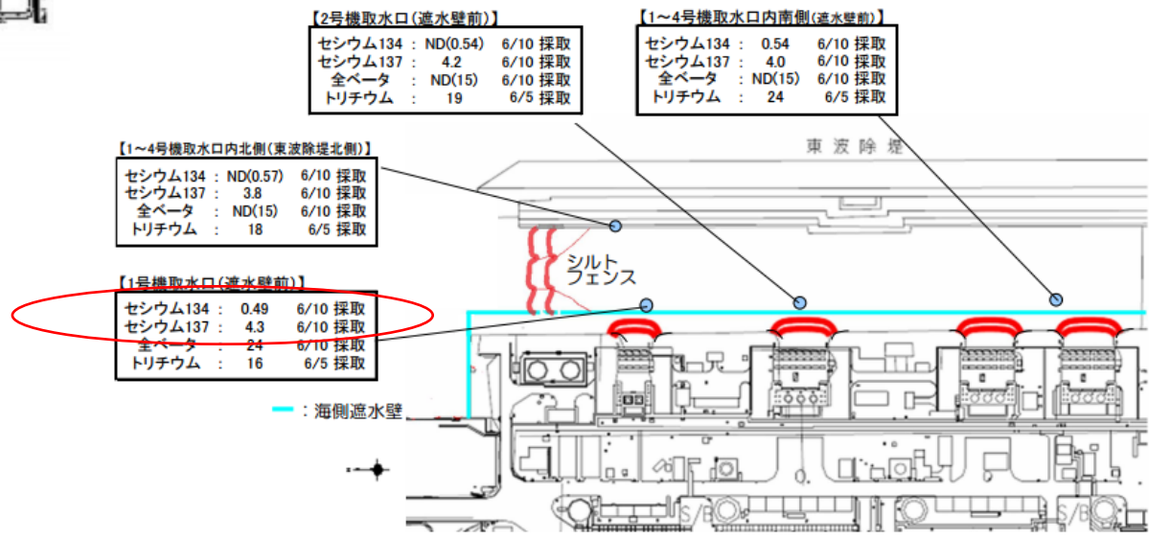
告示濃度限度:実用発電用原子炉の設置、運転等に関する規則に定める告示濃度限度(別表第2第六欄:周辺監視区域外の水中の濃度限度)

	data	date of sampling
Cs 134		
Cs 137		
All β		
tritium		

2017年6月12日0時現在

2. Sea water analysis data (Seawater intake)

単位:ベクレル/リットル、NDは検出限界値未満を表し、( )内に検出限界値を示す。
各地点の値は、「福島第一港湾内、放水口、護岸の詳細分析結果」の最新値。



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Q4. How many m^3 of cooling water is injected to reactors of Unit 1-3 at 2016.02?

Less than 9 m^3/h for Total of Unit 1-3

（Decreased from approx. 15 m^3 of last years)

Telephone Booth＝approx. 2m^3
Swimming Pool for Olympic
= approx. 2,500 m^3

- **Water Injection：9 ton/hour**
- **Temperature around Reactor? Approx. 20℃ (peripheral)**

（2017/6/12　18:00）	Unit 1	Unit 2	Unit 3
Temperature（℃）	21.1～21.3	27.1～27.4	22.7～24.6
Water Injected（㎥/h）	3.0	2.9	3.0
H2 Concentration（%）	0.00	0.04～0.05	0.02～0.03

How Fuel Derbis Retrieval will proceed?

- Objectives：Debris, sticking molten fuel, metal and concrete, will be removed as much as thoroughly
- Method：Grinding and cutting by robots

1）Vertical or horizontal： Merit and demerit

2）Flooding or In-air： Work under water preferred due to high dose rate

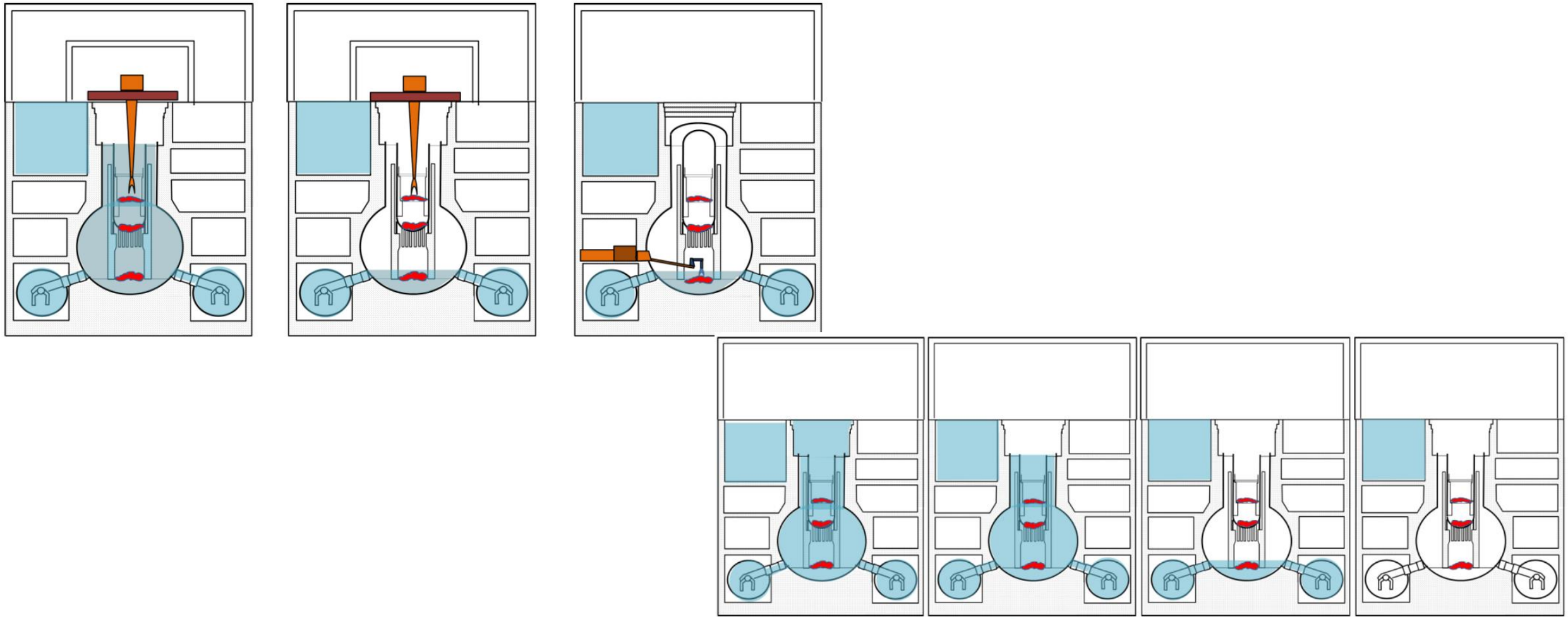
3) Dust and chip : High dose & Unknown =>Characterization needed & Effort to identify the technical method

- Way forward

No information yet where debris is located=>Intensive measurement of temperature, dose rate and placement etc.

Only 1-% attained?

Timing and methods to pull out contaminated water and stagnant watere



Q5. How many people are working at 1F in a day?

Number and Age of Workers

- **Total：approx. 6000（between 5,500 and 7.500 recently）**

＜1-1. 2012年7月以降の平日１日あたりの平均作業員数（実績値）の推移 ＞

- **Age: Mostly 40’s and 50’s**

  10’s 0.3%, 20’s 12.2%, 30’s 20.4%, 40’s 29.7%, 50’s 25.5%, 60’s 9.5%, No Answer 2.4%

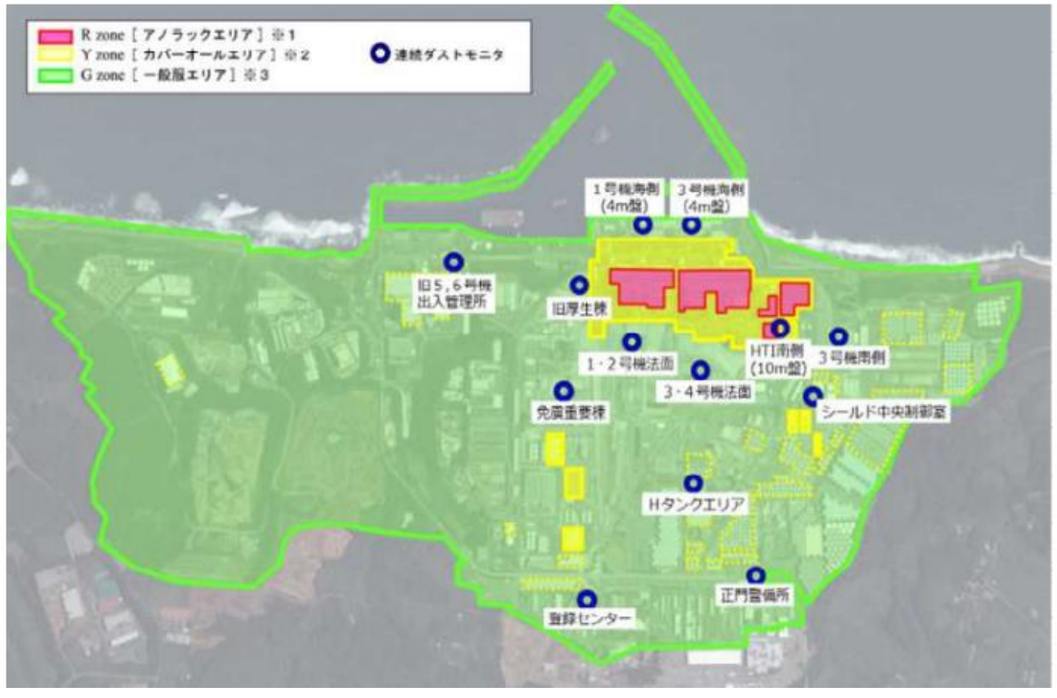
  （2016.12 7th Survey on Working Environment)

Working Environment, Local Employment, Assurance of Human Resources

- **Working Environment**

  Unit 1-4/Tank area/Auto Mobile Surveillance/Entry Control Building (2013/06 completed) /Large scale rest house/ Office Building/Canteen/Convenience shop・・・

=>New building ready, dose rate reduction easier clothes



- **Local Employment : 50% (Resident Card basis)**
- **How to secure workforce?**
  - **Secure and foster young resources (in view of 30-40 yeeas future)**
  - **Stable local work place on spot (dose rate, work description, salary)**

Q7. What is the monthly average dose rate for worker for 1F D&D?

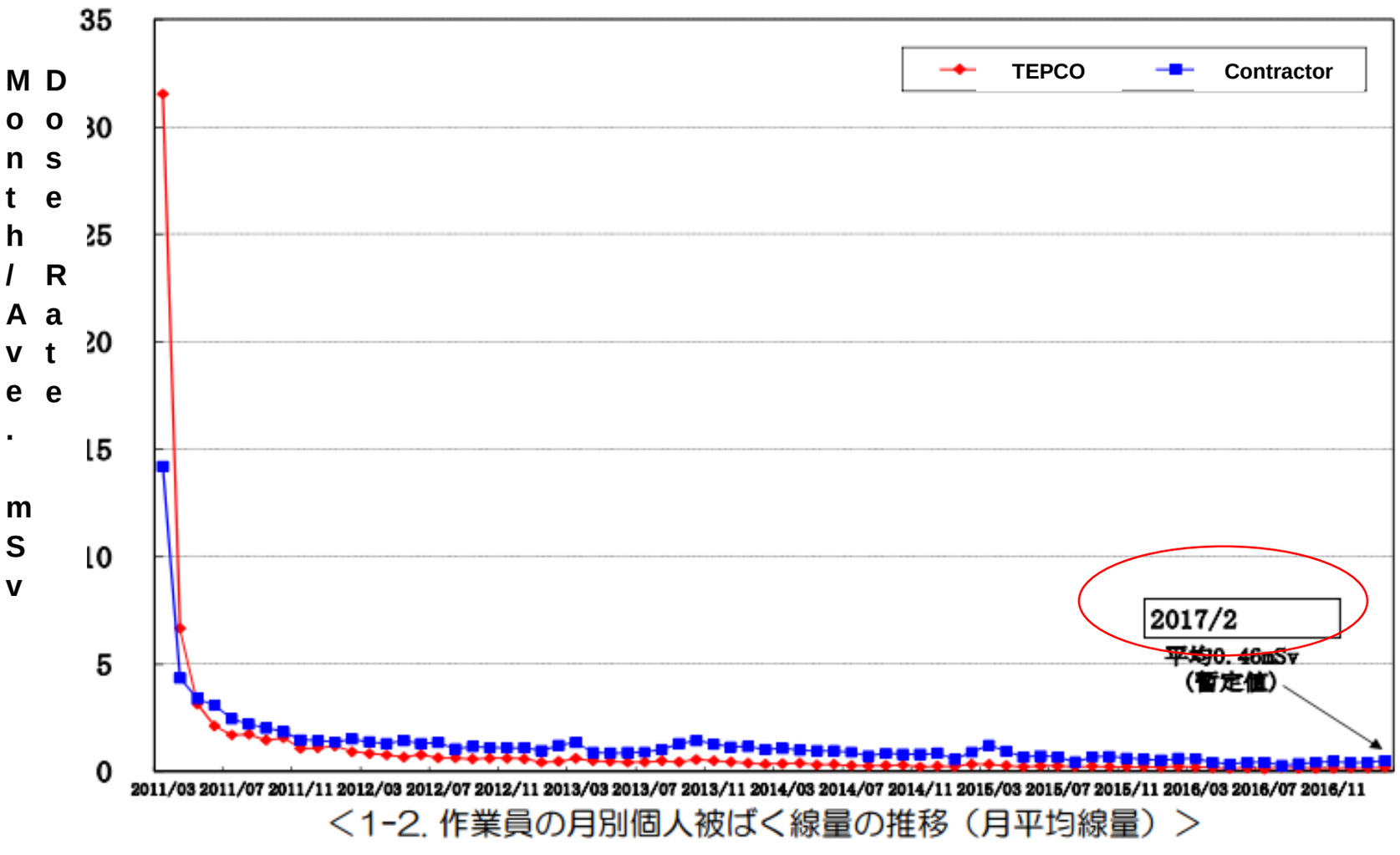
0.46 mSv

（Average dose rate in 2017.02)

Equivalent to 2.5 times flights between NY and Tokyo

Monthly dose rate

- **ca. 0.3-06 mSv/month**
  （cf. Chest X Ray 0.05 mSv. Narita-NY 0.1 mSv, Stock X Ray 5mSv, CT Scan 10mSv)
  - **At early stage TEPCO＞Contractors, after several months TEPCO ＜Contractors**
  - **After half a year, 1mSv level**



＜1-2. 作業員の月別個人被ばく線量の推移（月平均線量）＞

- Who are out of standards?＝Maximum?

Max. Monthly Dose Rate

2017.01

- **Less than 20mSv / month**
  - Intensive Dose Rate Management
  - Decontamination・Facing

１．**Effective Dose Rate by external Radiation (Past three months average)**

福島第一原子力発電所にて放射線業務に従事した作業者の過去３ヶ月の外部被ばく線量分布（各月別の全入域者数）を表１に示す。

表１　外部被ばく線量

区分(mSv)	2017.01			2017.02			2017.03		
	TEPCO	Contractor	計	TEPCO	Contractor	計	TEPCO	Contractor	計
100超え	0	0	0	0	0	0	0	0	0
75超え～100以下	0	0	0	0	0	0	0	0	0
50超え～75以下	0	0	0	0	0	0	0	0	0
20超え～50以下	0	0	0	0	0	0	0	0	0
10超え～20以下	0	5	5	0	6	6	0	28	28
5超え～10以下	0	69	69	0	121	121	0	142	142
1超え～5以下	24	785	809	49	1111	1160	34	1140	1174
1以下	1105	7729	8834	1127	7659	8786	1014	7404	8418
計	1129	8588	9717	1176	8897	10073	1048	8714	9762
最大(mSv)	2.40	11.00	11.00	3.40	13.70	13.70	3.51	18.92	18.92
平均(mSv)	0.15	0.42	0.38	0.17	0.53	0.48	0.17	0.58	0.54

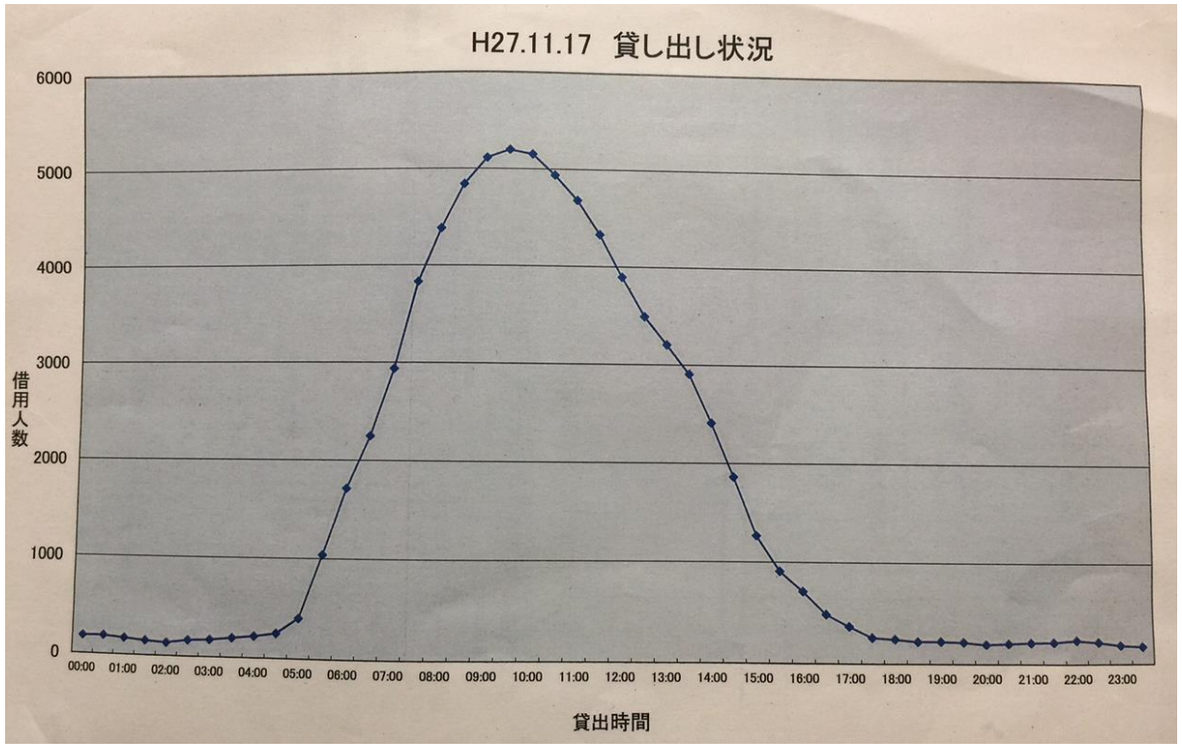
※ＡＰＤ値の積算値の積算型線量計による月間線量値への置き換えや、積算型線量計のみの着用者（例：免震棟のみの作業者）の値の反映等により線量・人数が変動することがある。

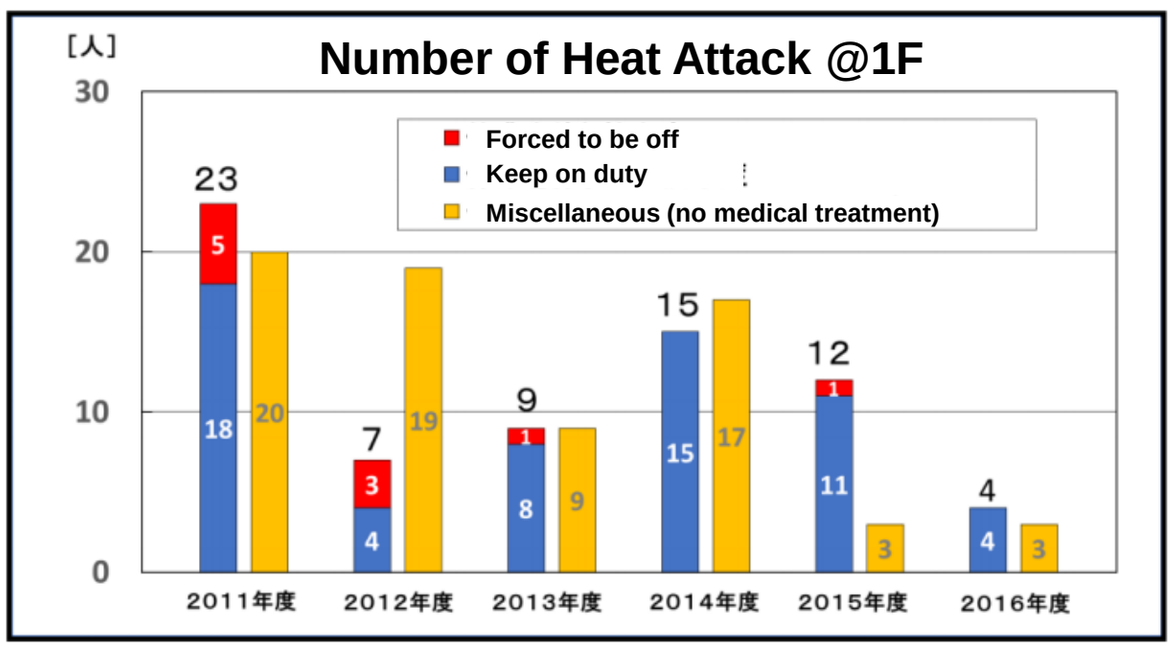
Q8. What is the peak time for workers staying in a day at 1F site?

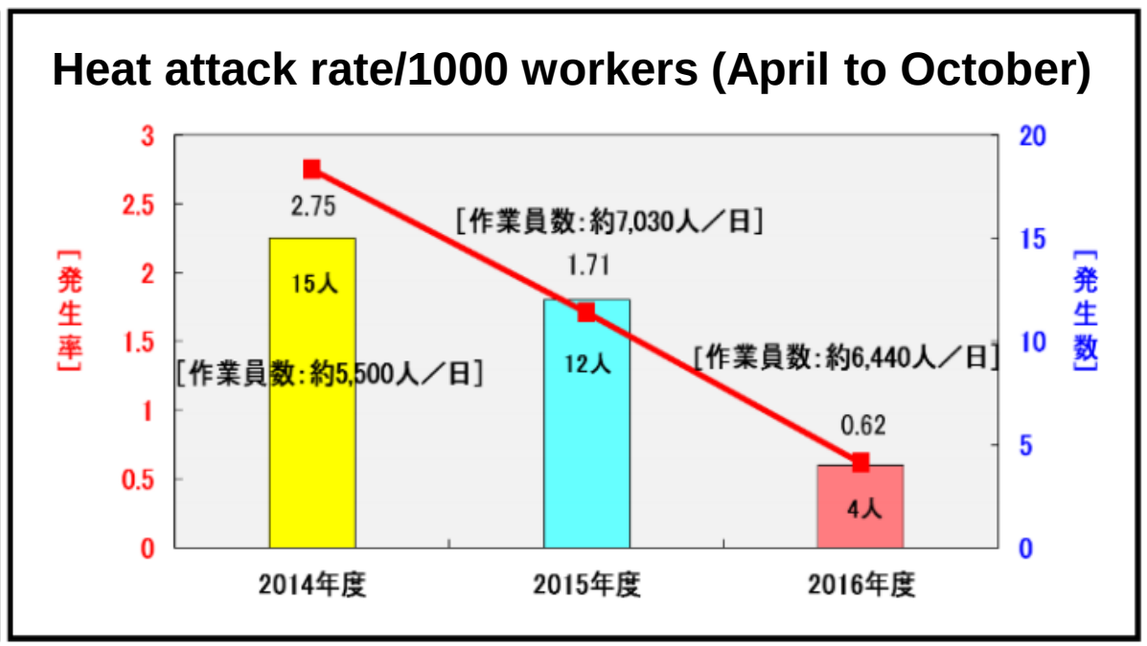
AM 9-10

Peak time of worker on site

- 9:00 AM
  - Preparedness for Heat Attack
- Improved Working Conditions
  - New Large Rest House
  - Fukushima Food Catering (2015 Spring)
  - Convenience Shop (2016.03)
  - Enlarged Parking Space
    (500 now→800)
  - New Office Building
  - Shower



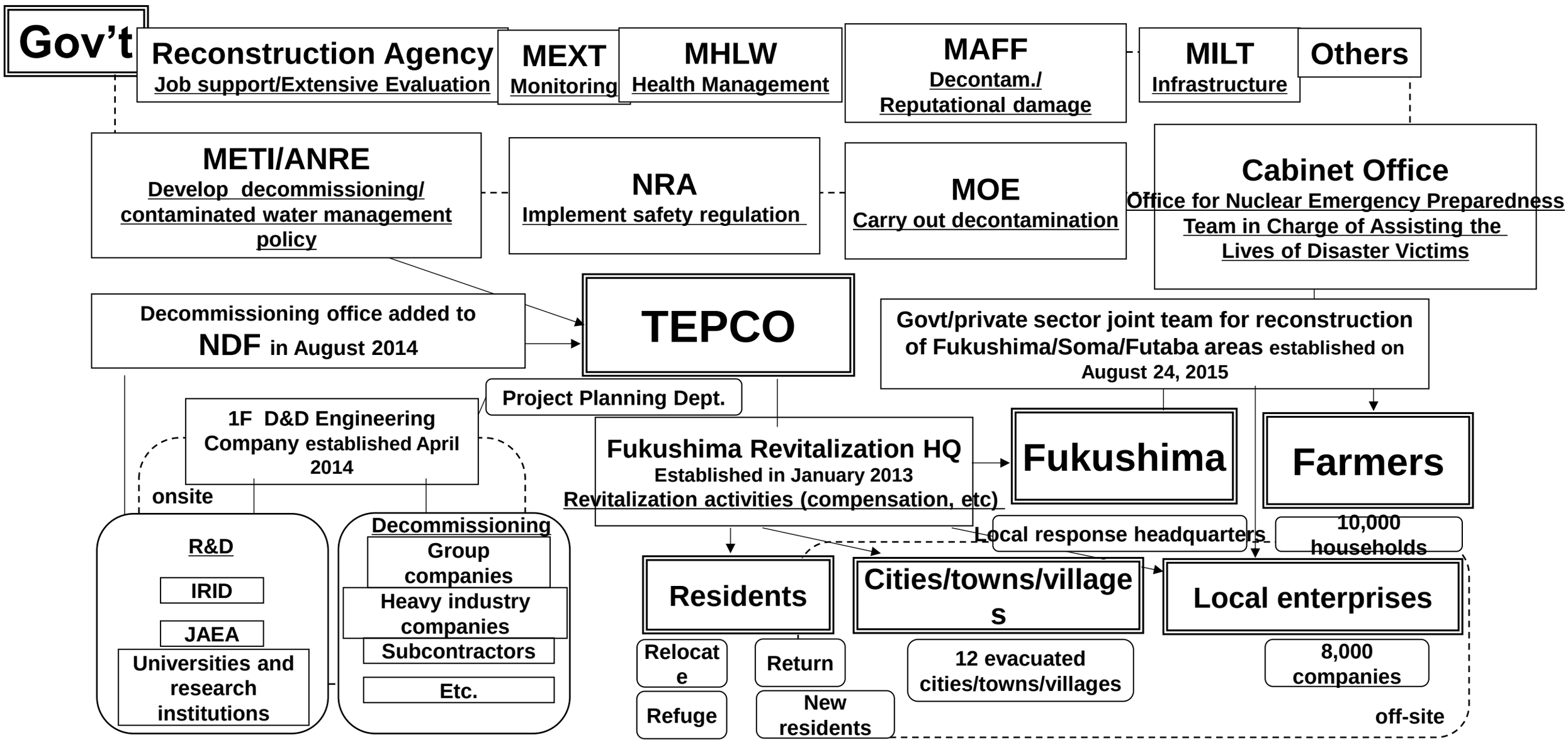




Who is doing what?

- **Major Players**
  - **Government　METI：D&D MOE：Decontamination、Office of Cabinet：Zoning etc.**
  - **TEPCO D&D Company, Fukushima Revitalization Headquarters：Compensation・Decontamination・Support to Revitalization**
  - **BDF & Public/Industry Team**

Organizations involved in D&D of Fukushima Daiichi



Conclusion

- **1F D&D is the cutting-edge challenge in the world. To proceed 1F D&D will change the world**
- **Change the communication method of “To listen to the local Voice”, “To disseminate the information” and “To share the information of D&D”**

  From “Governement and TEPCO → Local Community”

  To “ Local Community → Government and TEPCO”

  THIS FORUM SEIRVES FOR THIS CHANGE

- **Fukushima Problem should shift the focus to D&D Site Issue, though not forgetting Reputational Rumor etc. as a Whole Fukushima Issue**
- **D&D Issue is an issue of Unknown Unknowns**
- **Pivotal change from contaminated water to fuel debris retrieval**
- **New challenge to create better working conditions and infrastructure for 6000 workers**
- **New challenge like the disposal of the waste has to be taken up by ourselves.**

Thank you for your Attention