

Radiation Dose of Workers Engaged in Decontamination of Environment

December, 2020

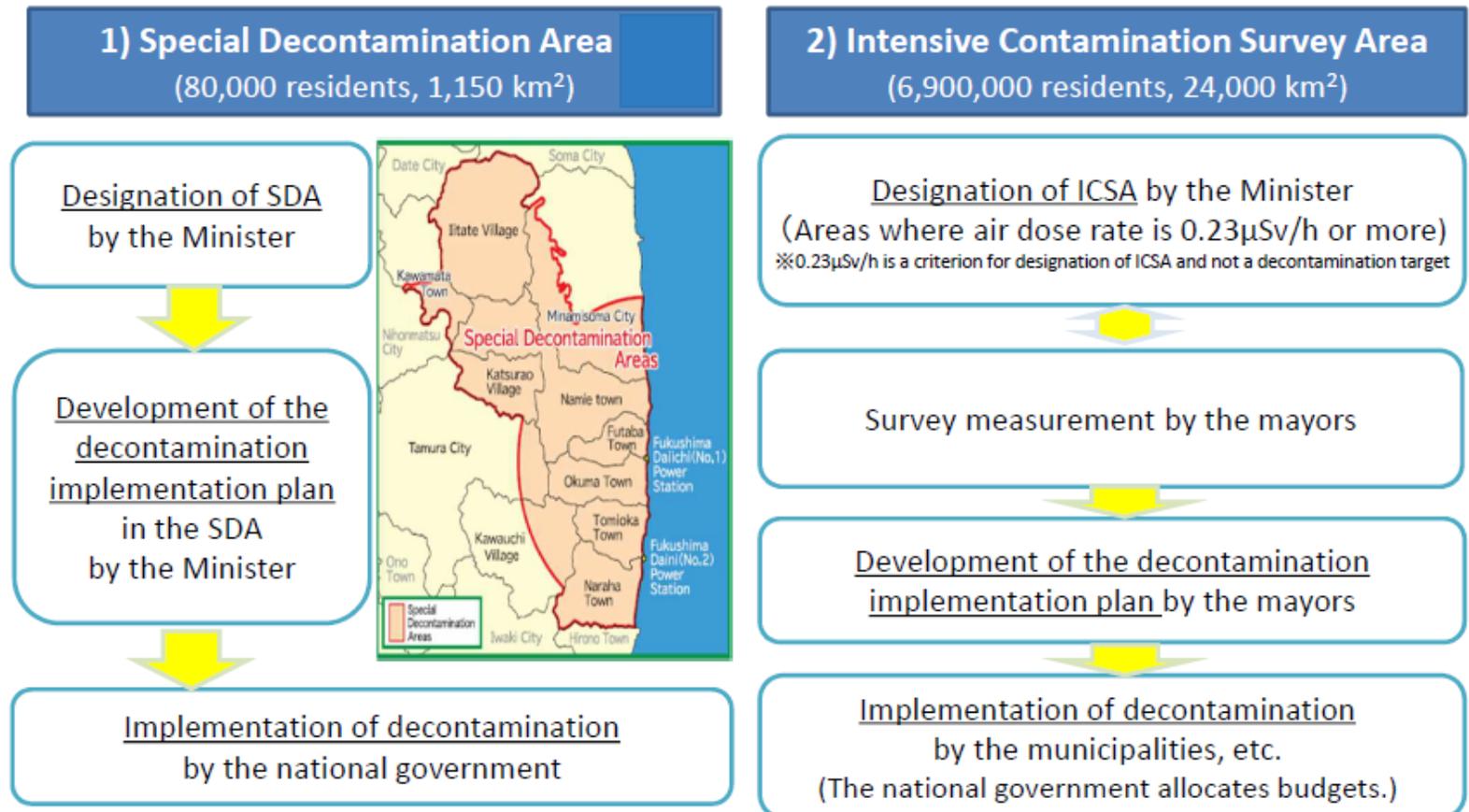
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Decontamination and related works after Great East Japan Earthquake and Tsunami

- The Great East Japan Earthquake and Tsunami on March 11, 2011 was followed by Fukushima-Daiichi Accident, which released radioactive materials, mainly Cs-134 and Cs-137, into the atmosphere resulting in contamination of environments including soil, woods, waters and houses.
- The government enacted the “Act on Special Measures Concerning the Handling of Radioactive Pollution” in January, 2012, in order to promote decontamination of the environment to facilitate the lifting of the evacuation order.
- The decontamination and related works are still in progress in the restricted area, especially in the Special Decontamination Area and Difficult-to-Return Zone.



Establishment of Radiation Dose Registration System for Decontamination and Related Workers

- The radiation dose registration system was emerged to prevent scattering and loss of radiation dose records, when the decontamination of the environment was initiated.
- The Radiation Dose Registration Center (RADREC) of the Radiation Effects Association has been operating a radiation dose registration system for nuclear workers since 1977. So the radiation dose registration system for decontamination and related workers was initiated in November 2013.
- In March 2015, the RADREC started operation of database system for dose records of decontamination and related workers.
- The system was established ;
 - to centralize radiation dose records, especially for subcontract workers changing jobs/projects frequently
 - to manage radiation dose records both nuclear and decontamination related workers
 - to collectively respond inquiry on past dose records
 - to prevent loss of dose records

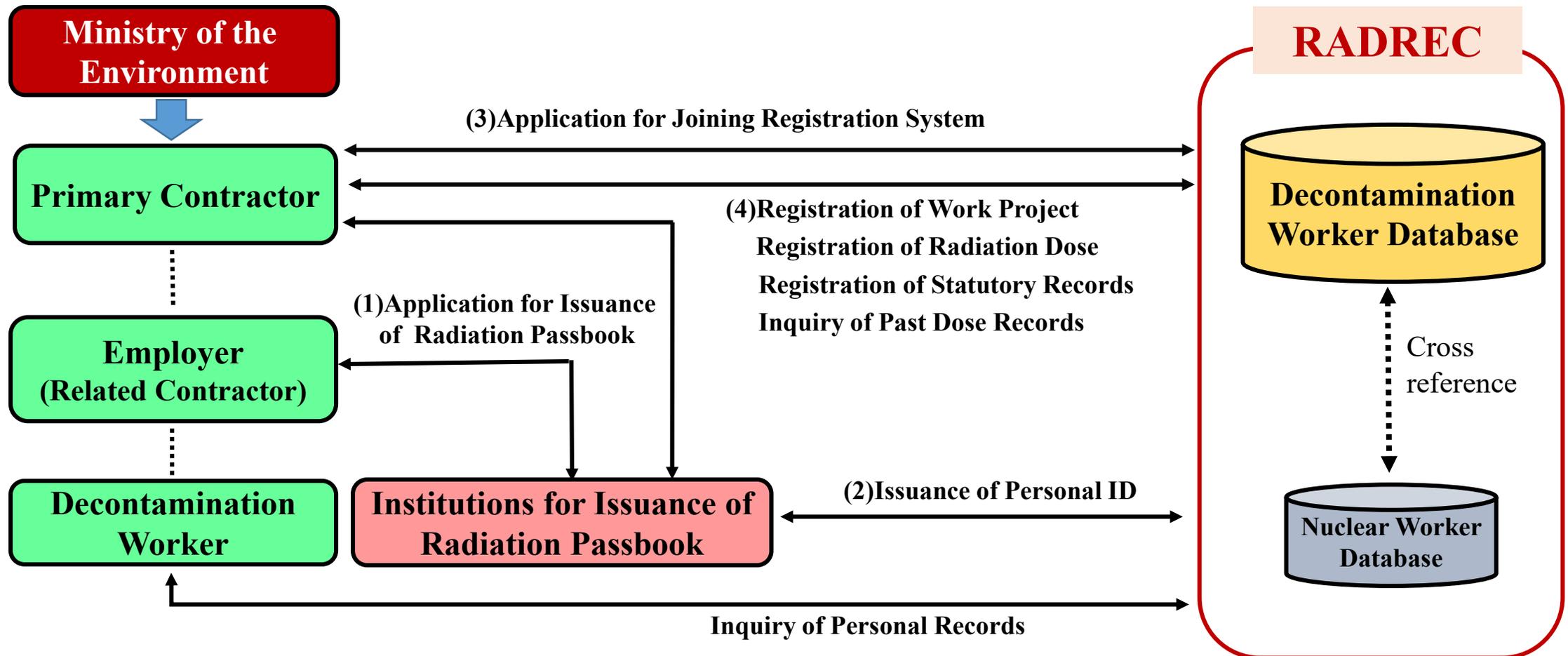
Work Categories and Registration Items

- The registration items for the RADREC database depend on the work categories.
- **Category I**
 - For the works **inside special decontamination area and waste disposal**, basically quarterly registration and following items are required considering the work in relatively **high radiation dose rate**.
- **Category II**
 - On the other hand, works **outside special decontamination area**, registration after works are required considering the work in relatively **low radiation dose rate**.

Work Category	Registration Items
<p><u>Category I</u></p> <ul style="list-style-type: none"> ● Decontamination and Related Work inside Special Decontamination Area ● Disposal of Specified Waste 	<ul style="list-style-type: none"> ➤ Issuance of Radiation Passbook for each worker ➤ Periodical Registration (Quarterly) of Radiation Dose ➤ Registration of Radiation Dose and Health Records after Work ➤ Past Dose Records Inquiry
<p><u>Category II</u></p> <ul style="list-style-type: none"> ● Decontamination and Related Work outside Special Decontamination Area including Intensive Contamination Survey Area 	<ul style="list-style-type: none"> ➤ Registration of Radiation Dose and Health Records after Work

Radiation Dose Registration System for Decontamination and Related Workers

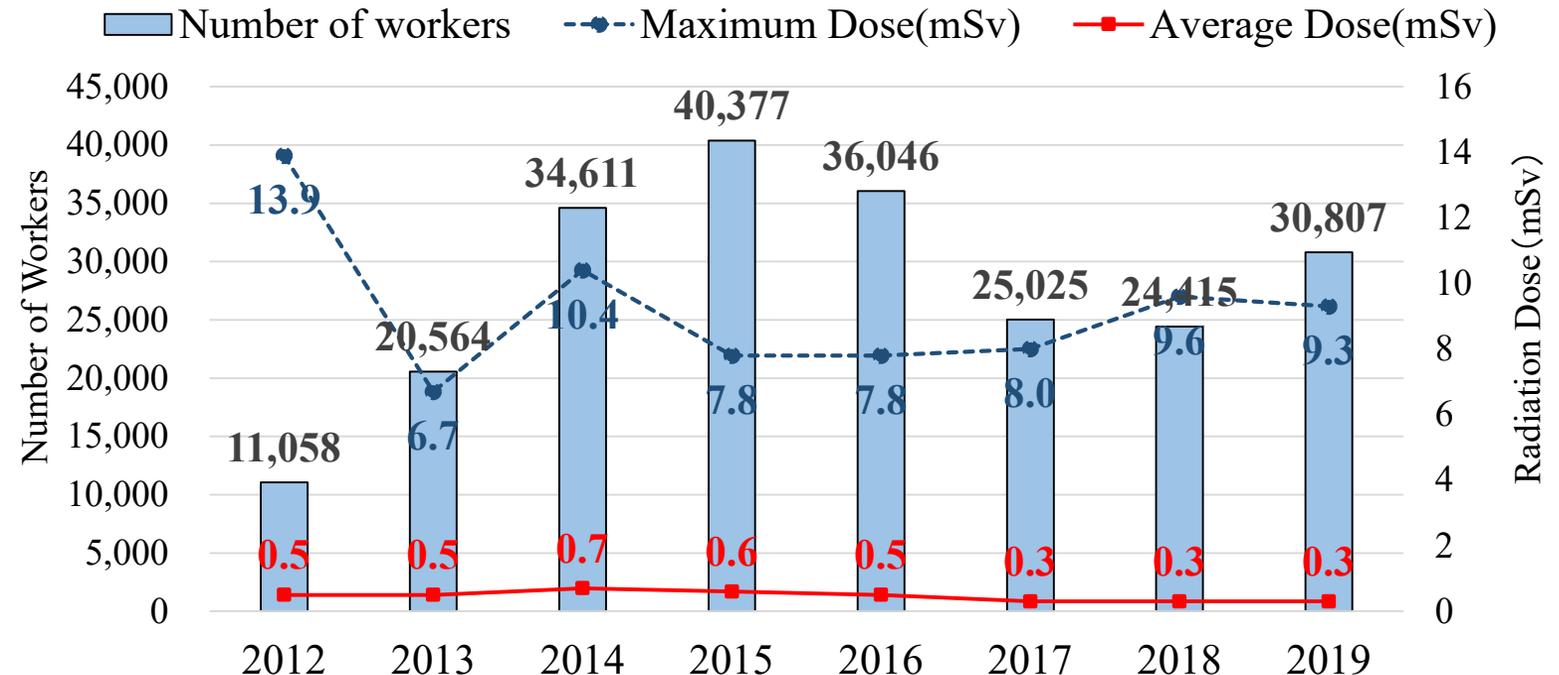
- Personal ID and Radiation Passbook are common with nuclear registration system.
- Registration and Inquiry of radiation dose can be done by on-line for primary contractors.
- Radiation dose for nuclear and decontamination can be cross referenced, as workers may go both.



Number of Workers, Average Dose and Maximum Dose

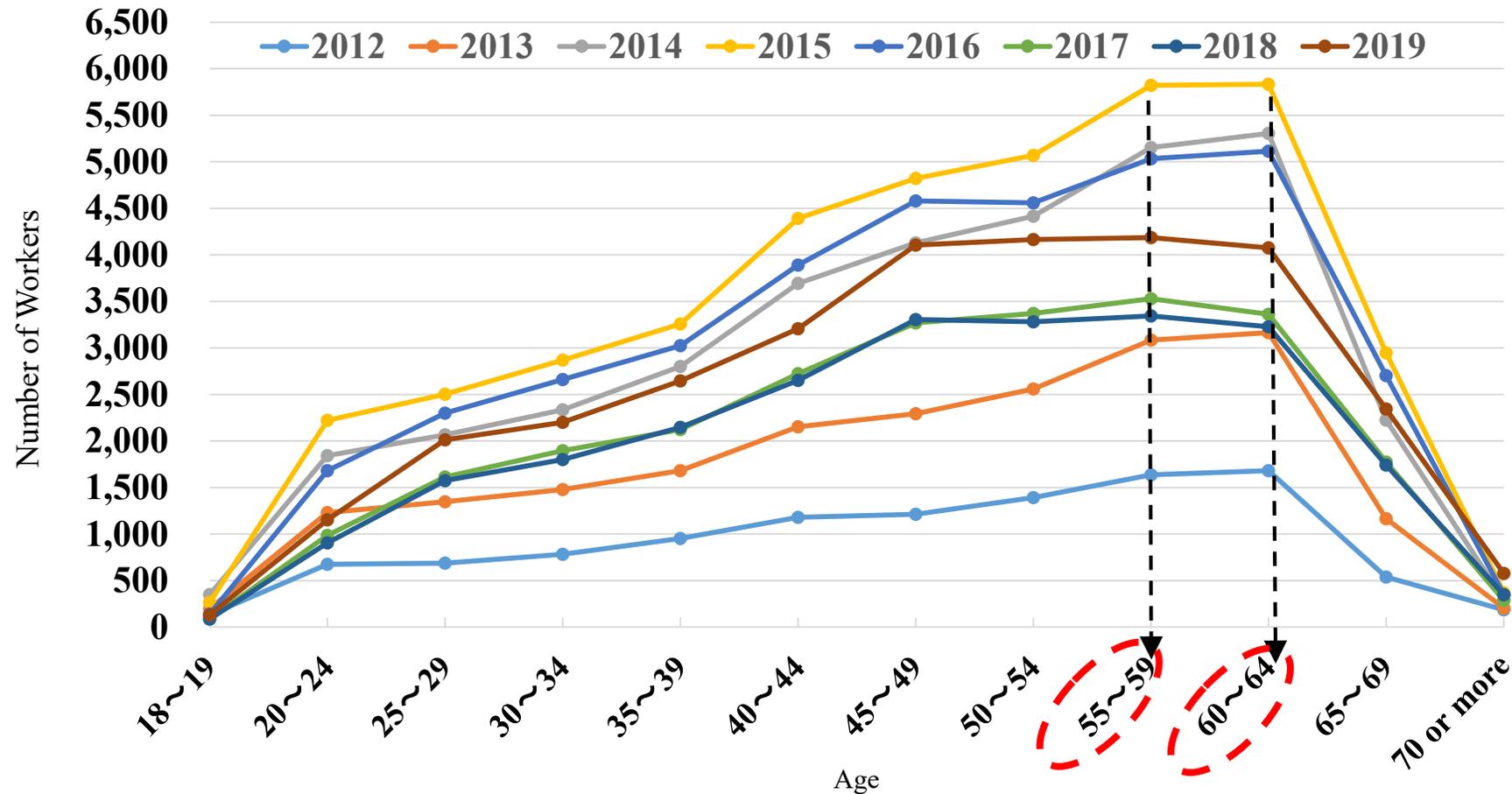
- As of November 1st, 2020, approximately 120 primary contractors of 750 recovery projects joined the RADREC registration framework and radiation dose of approximately 100,000 decontamination related workers are accumulated in the database, allowing the statistics on radiation dose. Even if the subcontract workers changed jobs/projects frequently, the radiation dose were aggregated by personal ID.
- Transitions of radiation dose of decontamination workers, average radiation dose and maximum dose registered during 2012-2019 are given in Figure. The registered data are mainly workers in the special decontamination area.

- The number of decontamination workers increased up to 2015, then decreased to 2017, because the operations of whole area decontamination were completed by the end of March 2017.
- No workers received an annual dose greater than 20 mSv. Recently, more than 90% of workers are less than 1 mSv.



Age Distribution of Workers

- The workers engaged in the **decontamination and related works are relatively high age, 50s-60s.**
- The number of age 60-64 workers were maximum during 2012-2016, since 2017, the number of age 55-59 workers became maximum.



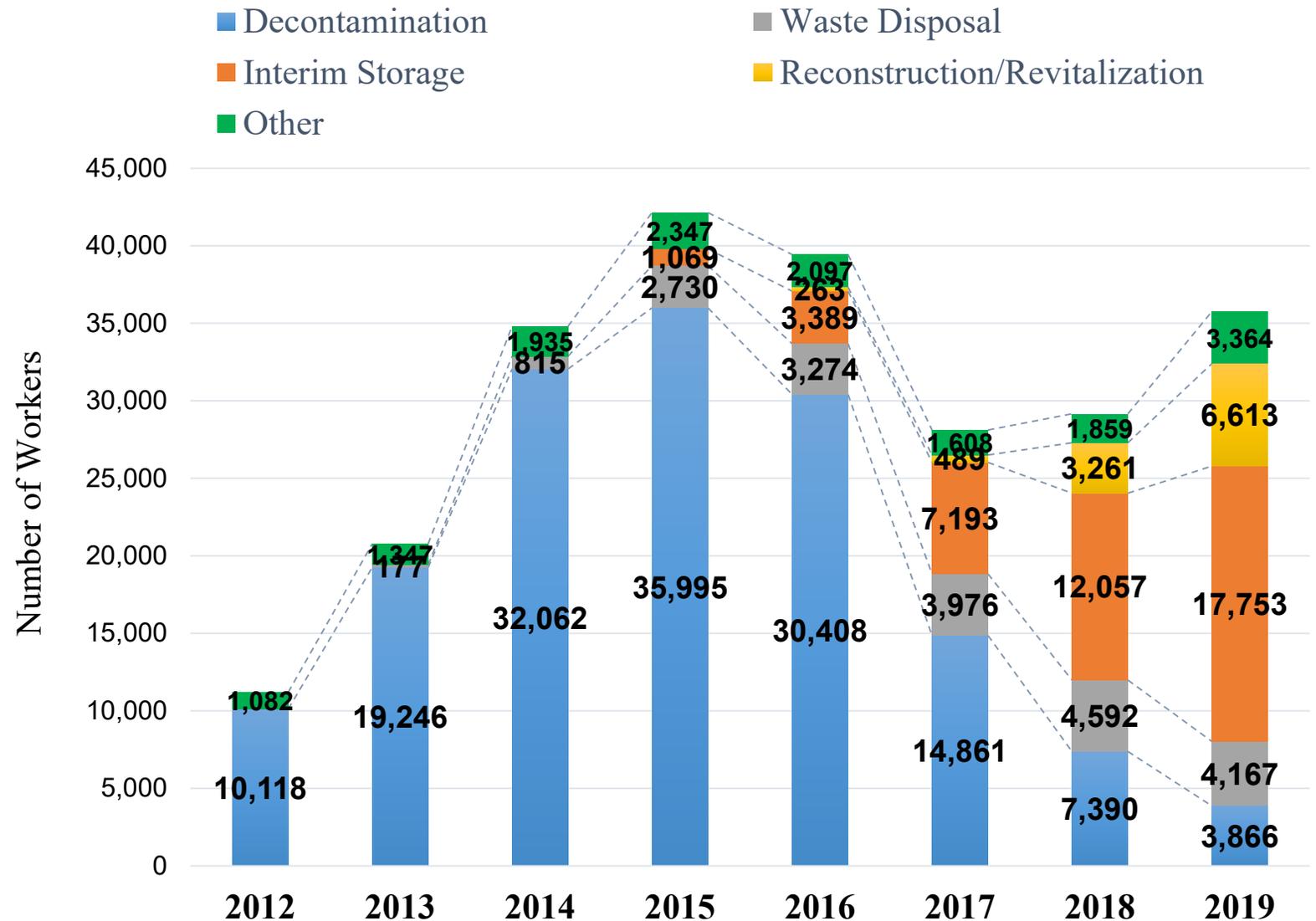
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Work Categories inside Special Decontamination Area

- Although the whole area decontamination in the Special Decontamination Area was completed by the end of March 2017, other related works are still in progress in the restricted area.
- In this presentation, workers are classified into **five categories** ;
 - **“Decontamination”** includes ;
 - ✓ whole area decontamination, land restoration in temporary storage site, demolition of houses in special decontamination area
 - **“Waste disposal”** includes ;
 - ✓ treatment of specified waste less than 100,000 Bq/kg, minimizing the waste volume, incineration facilities
 - **“Interim storage”** includes ;
 - ✓ construction of soil separation and storage facilities, transportation of soil and waste from temporary storage to interim storage facilities, processing and storage of soil and waste
 - **“Reconstruction/Revitalization”** includes ;
 - ✓ construction of specified reconstruction and revitalization base, demolition of houses and decontamination in 6 municipalities (Futaba, Okuma, Namie, Tomioka, Iitate and Katsurao)
 - **“Others”** includes ;
 - ✓ radiation monitoring, management support for construction, consultants, road constructions
- The categories above are classified using the **titles of work projects registered in the RADREC database.**

Number of Workers in Each Category

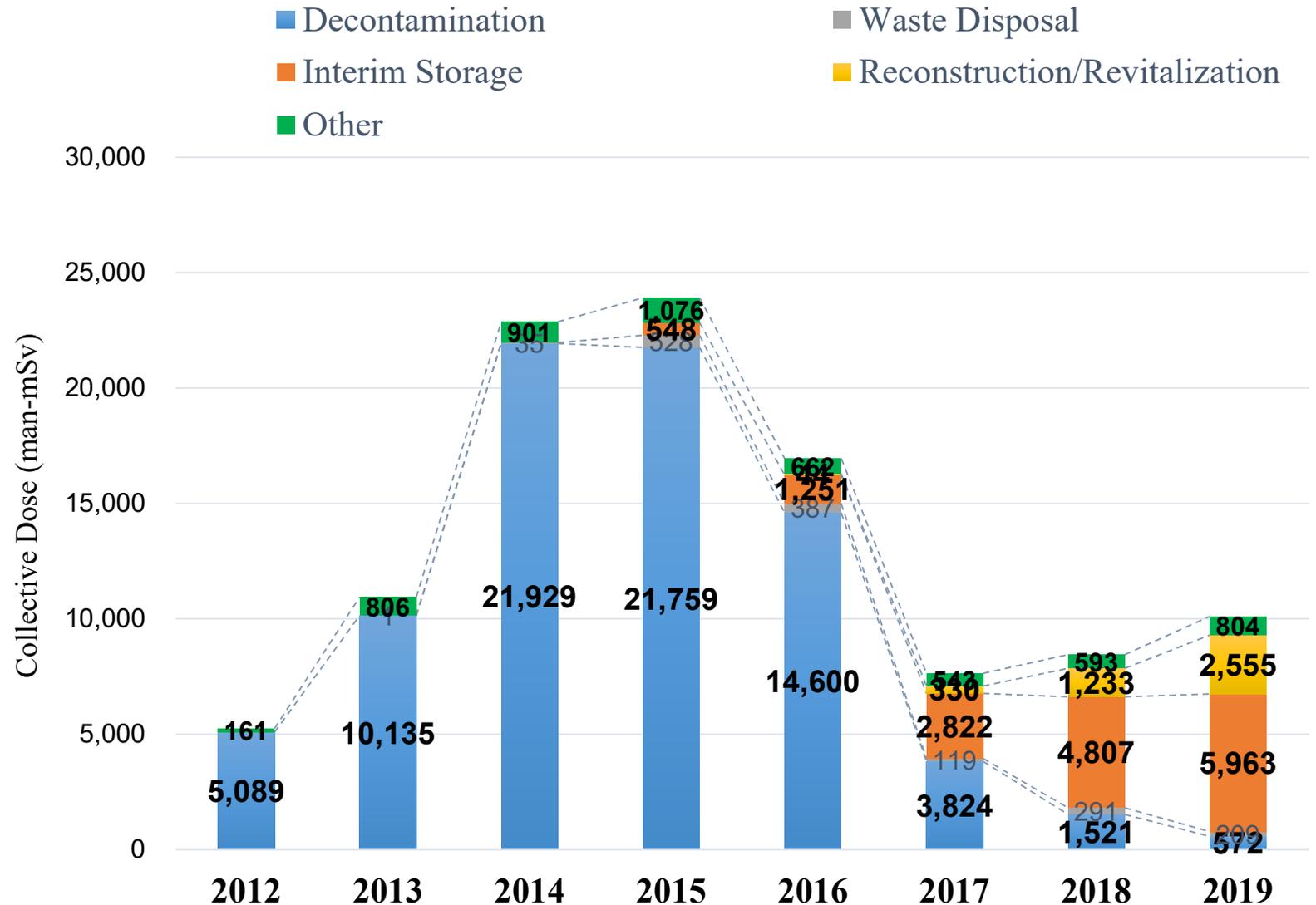
- As the whole area decontamination in the Special Decontamination Area was completed by the end of March 2017, **number of decontamination workers are decreasing.**
- As the constructions of Interim Storage Facilities and Specified Reconstruction /Revitalization Base are in operation, **number of these workers are increasing since 2015.**
- In 2015, number of workers of Interim Storage was approx. 2%, but in 2019, approx. 50%



Remark : The workers engaged in multiple projects are accounted in each category.

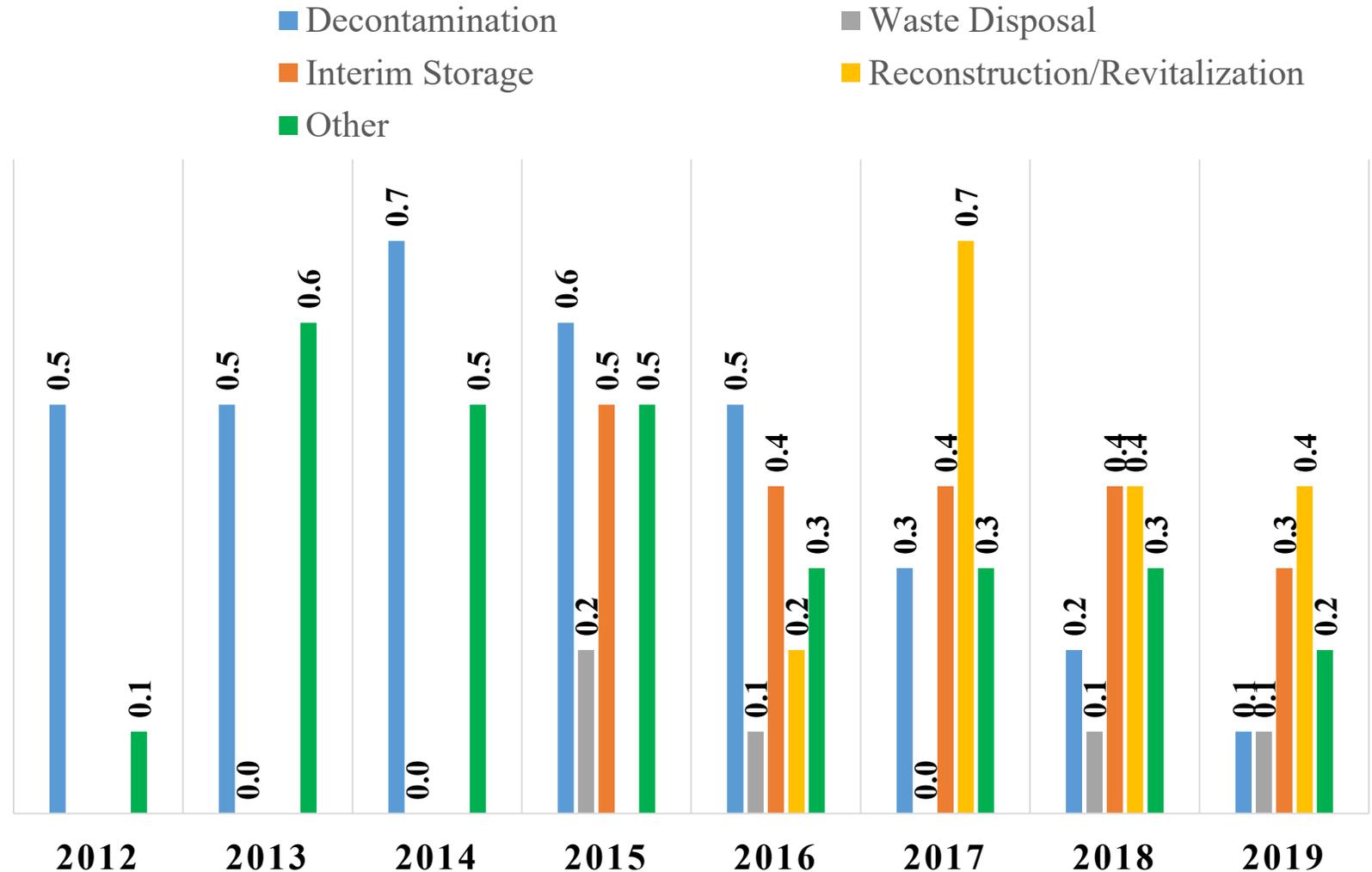
Collective Dose

- The collective dose of **decontamination workers** was **dominant during 2012-2016**.
- After the whole area decontamination was completed, the collective dose of **construction of interim storage and specified reconstruction/revitalization base** are becoming significant.



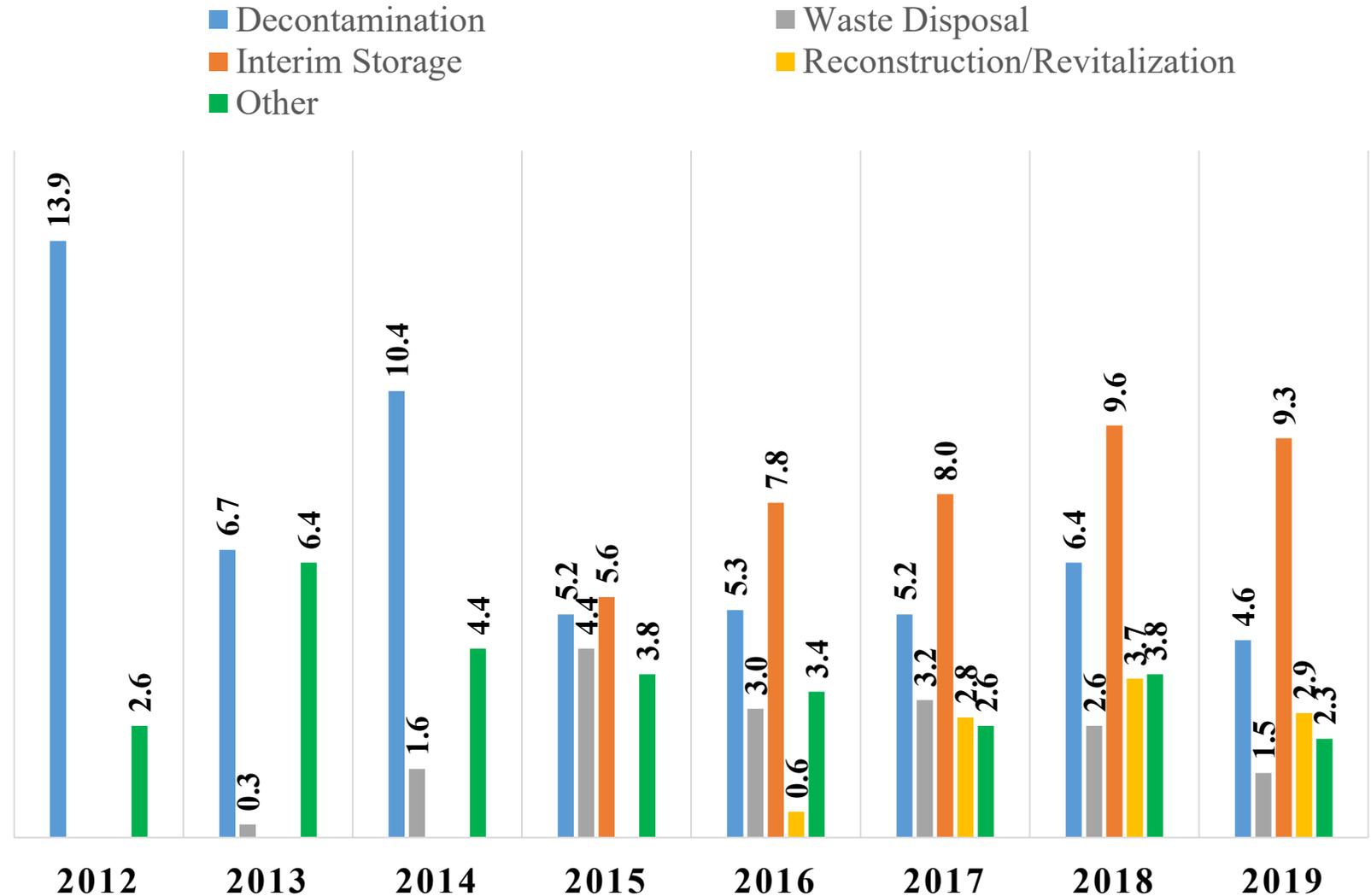
Average Dose

- The average doses for **whole area decontamination** in 2012-2016 were **0.5-0.7 mSv/y**
- The work of **interim storage** includes demolition of housings and decontamination in the Special Decontamination Area, average doses were **0.3-0.5 mSv/y**
- The average doses for **specified reconstruction/revitalization base** were **0.2-0.7 mSv/y**, relatively high because projects are implemented in “Difficult-to-Return Zone”
- The work of **waste disposal** includes handling of waste less than 100,000 Bq/kg, and works outside special decontamination area, average doses are **relatively low**.



Maximum Dose

- Maximum dose in 2012 for decontamination worker included radiation dose in 2011 by JAEA Pilot Project.
- Maximum dose during 2012-2014 was due to decontamination work.
- Maximum dose since 2015 due to interim storage workers, especially managers of the projects tend to stay longer in each site.
- No workers received an annual dose greater than 20 mSv



Remark : Because the decontamination worker of 5.2 mSv in 2015 engaged in multiple categories, it did not match with maximum dose of 7.8 mSv in 2015 in page 6.

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Comparison of Radiation Doses for Decontamination and Nuclear Workers

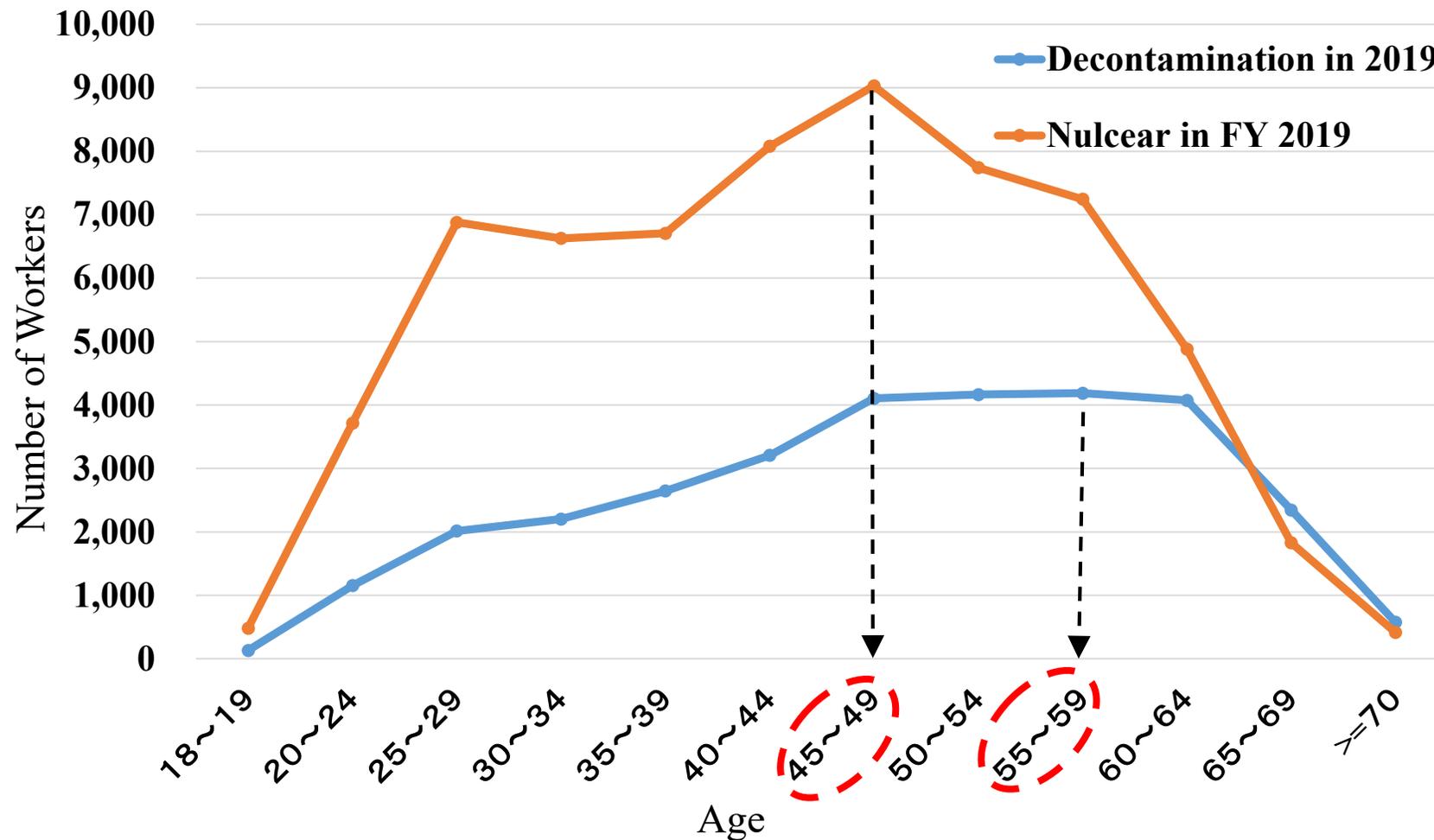
- Compared with the nuclear workers, the number of workers and the doses are relatively **low for decontamination**.

	Decontamination Related Worker (Jan.-Dec., 2019)	Nuclear Worker (Apr.,2019 – Mar.,2020)*
Number of Workers	30,807	63,638
Average Dose (mSv)	0.3	0.6
Maximum Dose (mSv)	9.3	19.6
Collective Dose (man-mSv)	10,103	36,174

* Including radiation dose of workers engaged in Fukushima Daiichi decommissioning

Age of Workers

- In the decontamination and related work, relatively **higher age workers** are employed compared with nuclear worker.



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Conclusions

- The radiation dose registry for decontamination and related workers has been **successfully established**.
- Although the whole area decontamination in the Special Decontamination Area were completed by the end of March 2017, other related works are still in progress. Especially, **the construction and operation of interim storage facilities, construction of specified reconstruction and revitalization base are becoming important**.
- Compared with the nuclear workers, the number of workers and the **doses of decontamination and related workers are relatively low**.
- The radiation dose registration system operated by the RADREC provides essential information for radiation safety of workers, as well as for nuclear workers.
- The work of recovery responders within the restricted areas may change in the long-term phase in the affected area after nuclear accident. The **preparedness for the dose registration system may be important for the recovery process**.