# Discussion on Analysis and Optimization of Collective Dose in China National Nuclear Power Company

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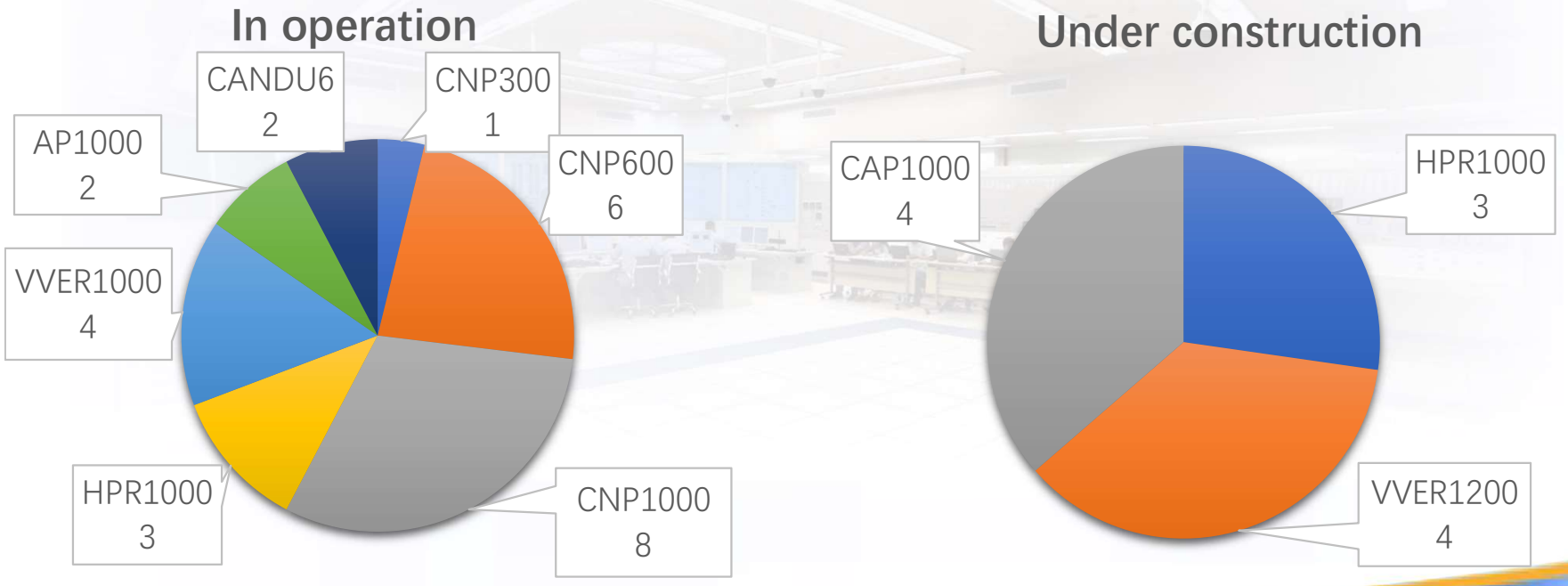
CONTENTS

# 01 Introduction

## Background

- With the rapid development of China's nuclear power industry, the number of nuclear power plants continues to increase.



# 01 Introduction

## Brief summary of 2024

- 18 units (total 26 in operation) were overhauled.
- 7 units better than the WANO advanced value (26.9%), 10 units between the WANO advanced and intermediate value (38.4%), 4 units between WANO intermediate and 3/4 value (15.4%), 4 units worse than WANO 3/4 value (15.4%).
- The average dose of a single unit of CNNP was 332.799 man.mSv/reactor-year, which is at a better level than the ISOE value among all nuclear power units in the world.

# 02 Collective Dose in CNNP

## Three-year averaged collective dose from 2022 to 2024

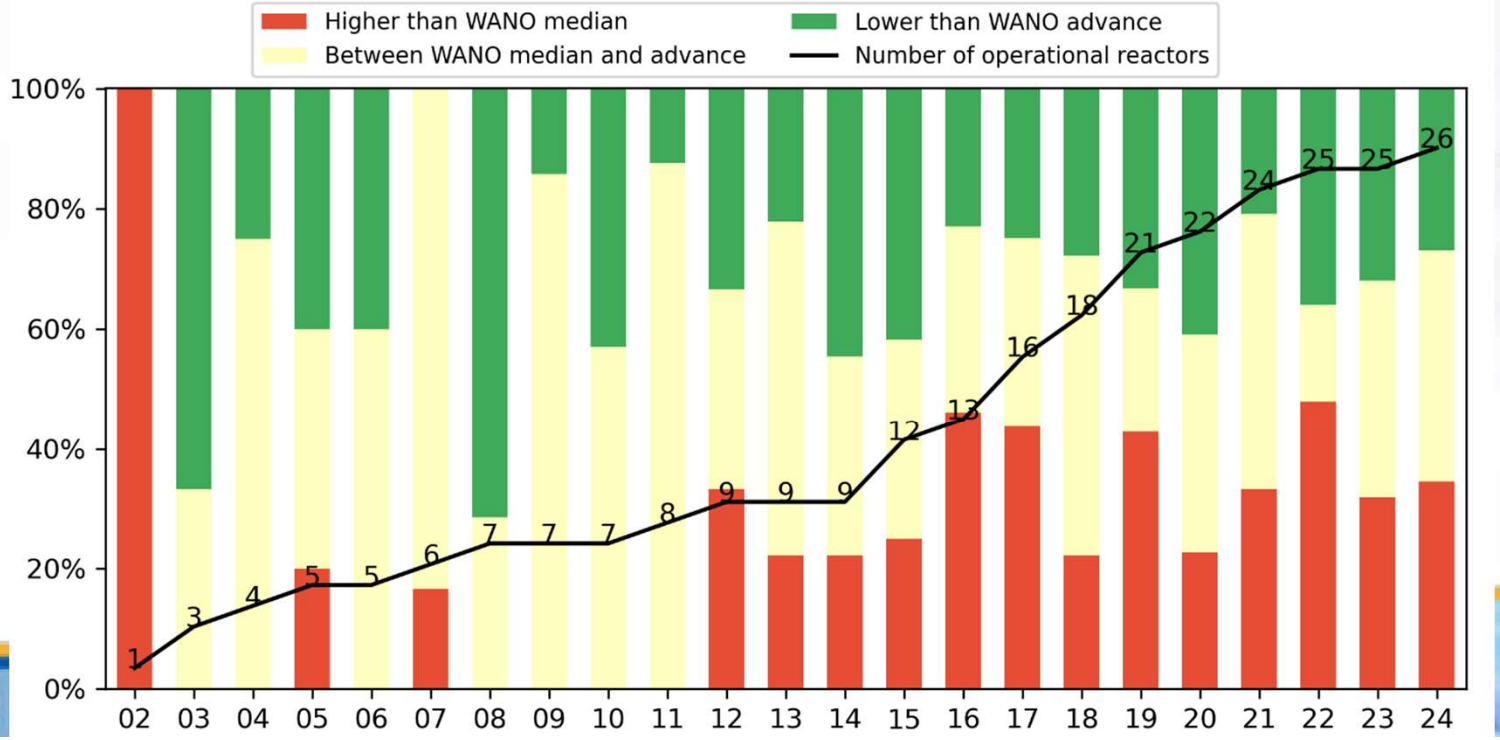
- WANO median value is ~340 man.mSv over the past three years.
- VVER1000 is basically better than WANO median value.
- CANDU6 and CNP1000 are basically worse than the WANO median.
- CNP300, CNP600 and AP1000 are in the middle, and most are better than WANO median value.

| Reactor type | Collective Dose (man.mSv) | WANO Advanced Value (man.mSv) | WANO Median Value (man.mSv) |
|---|---|---|---|
| CNP300 | 351 | 145.3 (156 in 2024) | 341 (336 in 2024) |
| CNP600 | 211.5 | | |
| CNP1000 | 387.3 | | |
| HPR1000 | 214.4 | | |
| VVER | 195.6 | | |
| AP1000 | 234 | | |
| CANDU6 | 621.2 | | |

# 02 Collective Dose in CNNP

## Collective dose over past years from 2002 to 2024

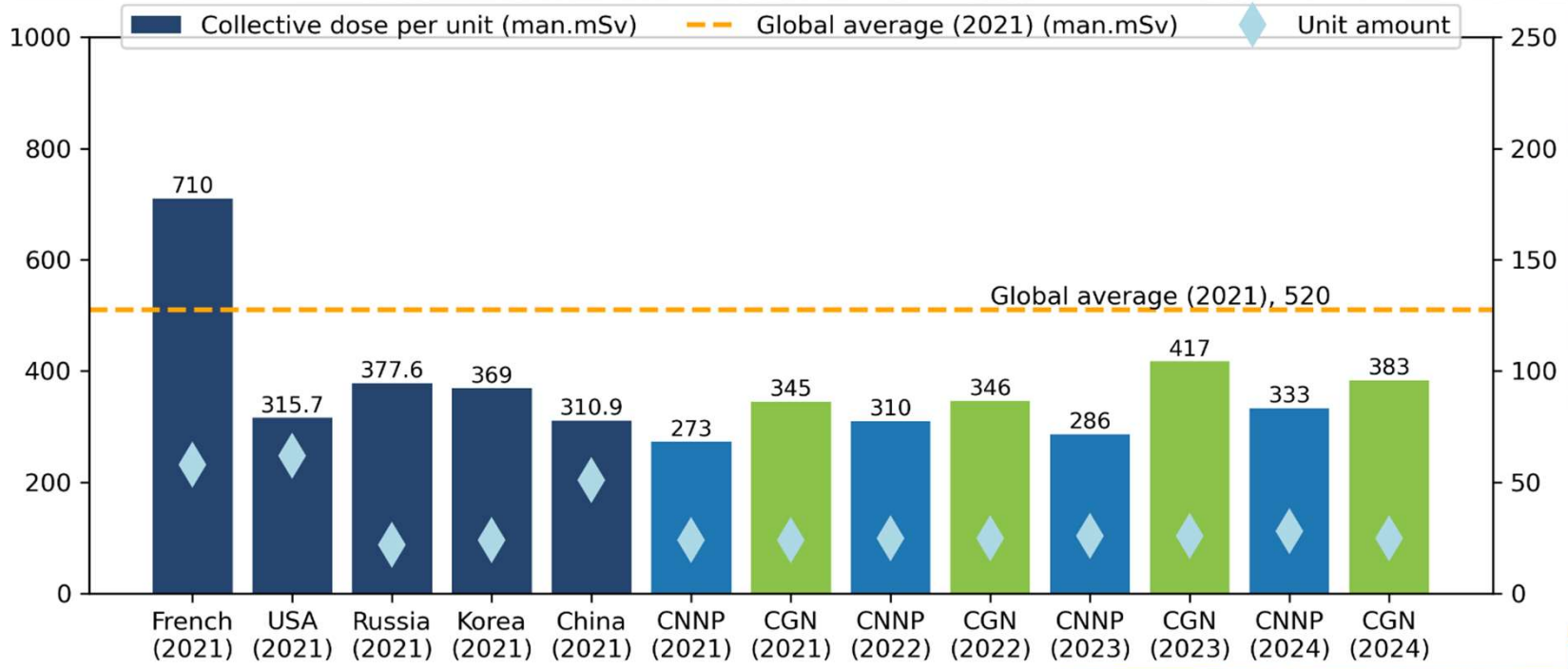
- From 2002 to 2011, the collective dose of most of the units of Chinese nuclear power plants in operation was better than the median value of WANO.
- With increase of overhaul and decrease of WANO median value, the number of units higher than WANO median value increased after 2011.



# 02 Collective Dose in CNNP

## Comparison with other NPPs

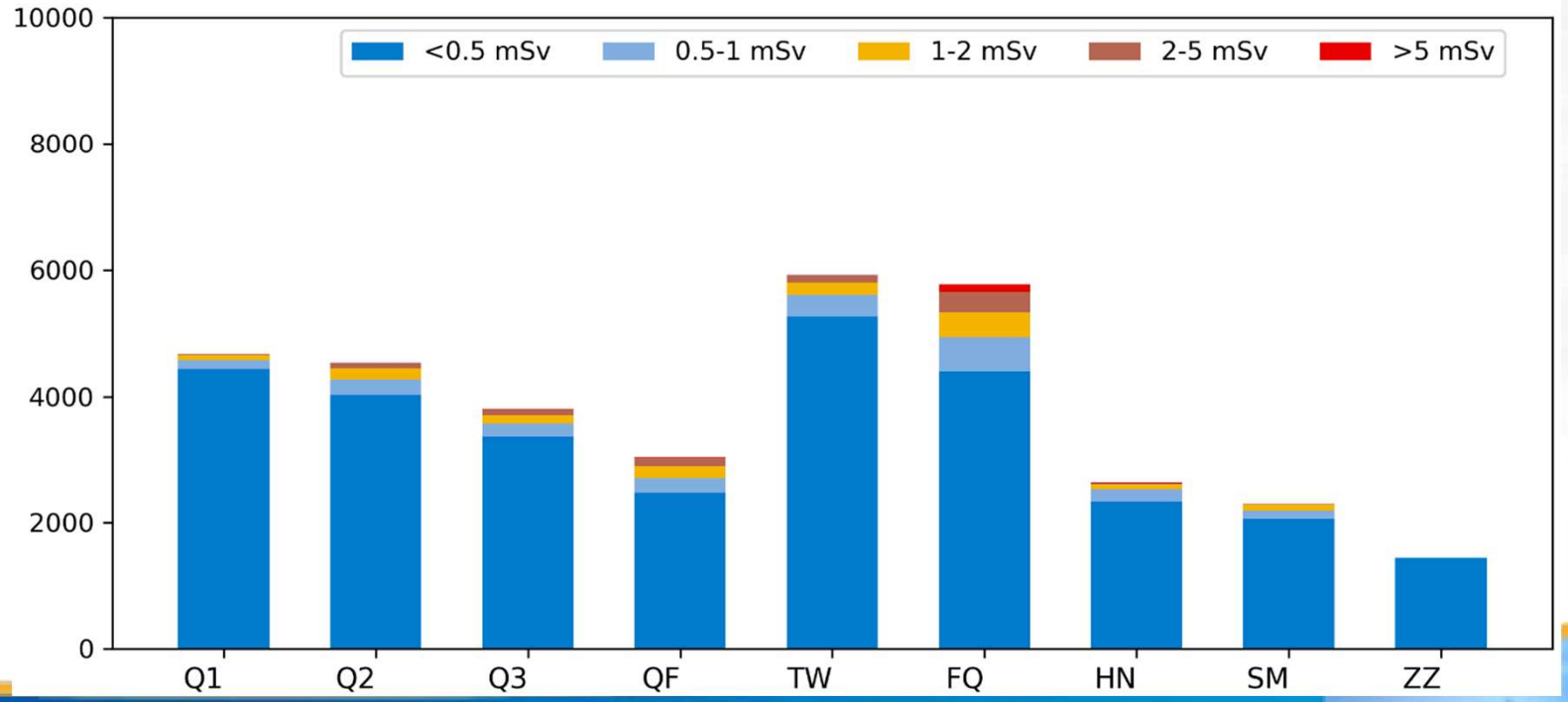
- The average collective dose per unit of CNNP is 332.799 man.mSv in 2024.
- Compared with CGN, CNNP has relative low collective dose in the past four years.



# 02 Collective Dose in CNNP

## Individual dose distribution

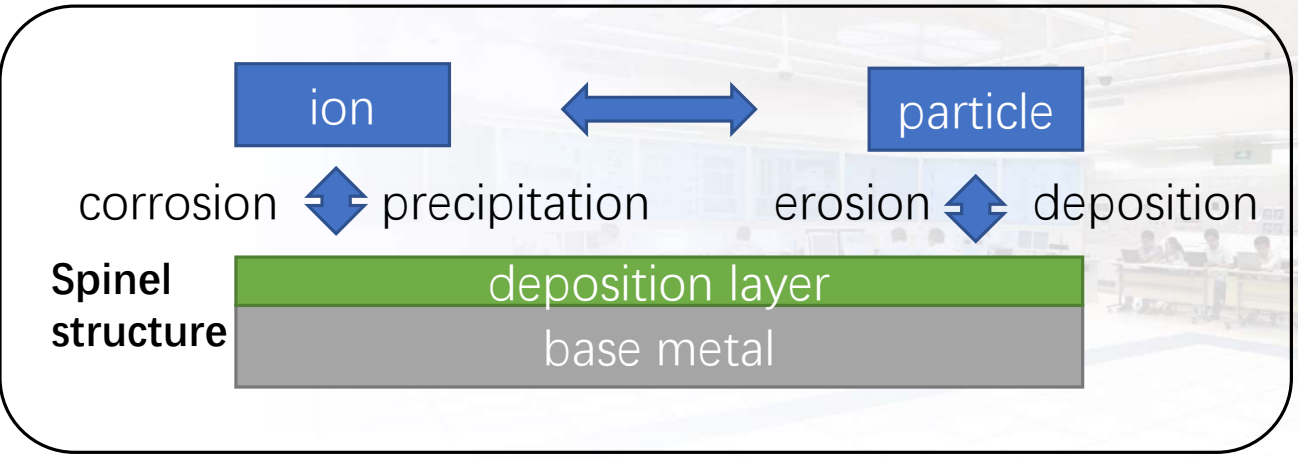
- In 2024, 80% was lower than 0.5 mSv, 90% was lower than 1 mSv.
- In 2024, >5 mSv declined slightly.
- >5 mSv accounts for more than 1% of the total number of people in FQNPP.



# 03 Collective Dose Optimization

## Oxidation operation and Zinc injection

- Controlling ACPs source term helps lower collective dose.
- Zinc injection is being promoted in CNNP.



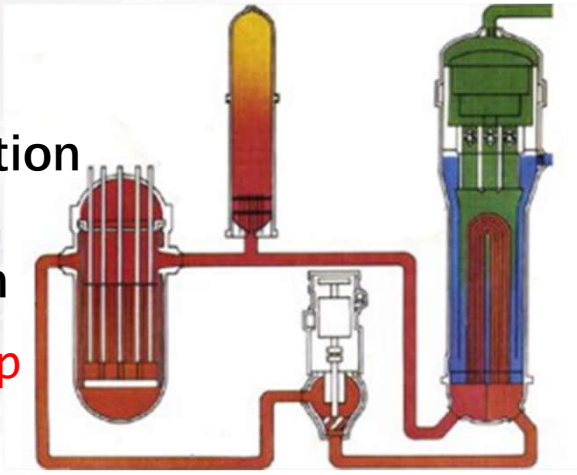

**CPs production**

**CPs deposition**

**CPs activation**

$^{58}Ni+n \rightarrow {}^{58}Co+p$

$^{59}Co+n \rightarrow {}^{60}Co$



**CPs migration**

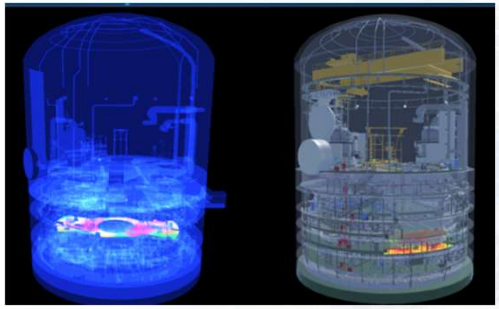
**Challenge: Safety analysis for CIPS and CILC after Zinc injection**

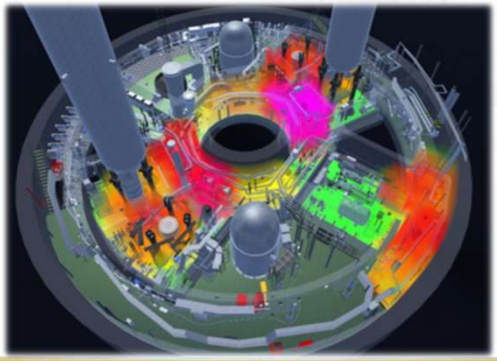
# 03 Collective Dose Optimization

## Information system & New equipment

- **3D Radiation Field Visualization**

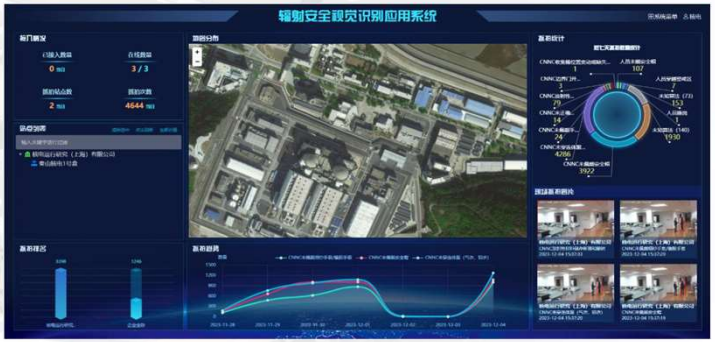
Support for radiation protection management, such as dose estimation for high-risk tasks, path guidance in plant.

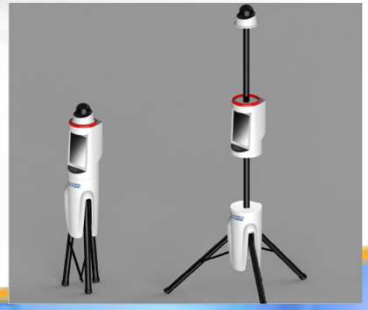




- **Vision-Based Radiation Safety Recognition System**

Support for automatic monitoring and warning of personnel radiation protection behavior.



# 04 Conclusion

- Compared with WANO advanced and median values, CNNP have maintained low levels over the long term, but overall, there remains pressure for continuous optimization.
- In terms of individual dose control, CNNP comply with international and national standards without exceeding limits, reflecting a high level of radiation protection management.
- For collective dose optimization, the rational application of oxidation operation technology, the development of informatization system and new equipment in radiation protection help for collective dose control.

# Thank you for your attention

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