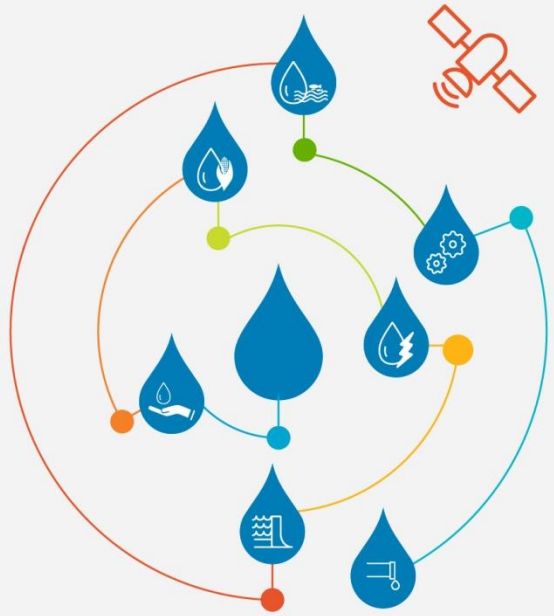
Upgrading Dam Under Operation with Dam Piercing



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3 October 2018

Advanced Technologies to Upgrade Dam in Japan

Advanced Technologies	
	to increase reservoir volume
	to increase discharge capacity
	to improve structural stability
	to improve operation
	To control sediment
	To Improve environments

- Piercing existing dam bodies
- Constructing additional power plants

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General

- General

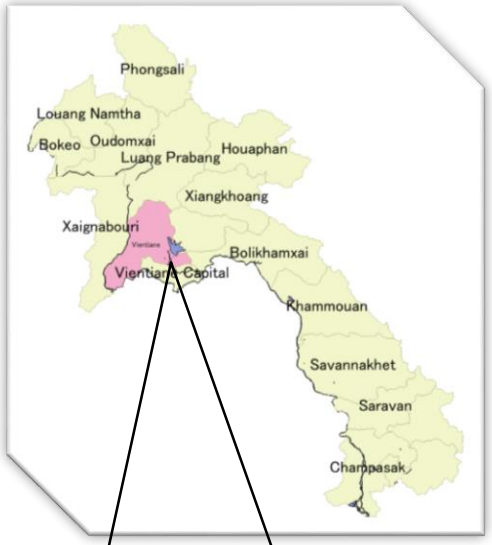
  Piercing of existing dam body from downstream for the purpose to increase discharge capacity has become one of the reliable technology in Japan as a consequence of many domestic experiences.

- Examples of actual application of the innovation

  Nam Ngum 1 Dam was completed in 1971.
  The expansion project is to construct a new intake, waterway, and powerhouse for Unit No.6, which involves piercing of the existing dam body for accommodating the intake and waterway there.

  Design discharge of this waterway is 111.2 m^3/s. The powerhouse to accommodate 40MW generating equipment is positioned in line with the existing one, adjacent to the downstream face of the dam. This construction also involves installation of temporary coffering bulkhead which stands against the water head of more than 30 m.

Nam Ngum 1 Dam in Lao PDR

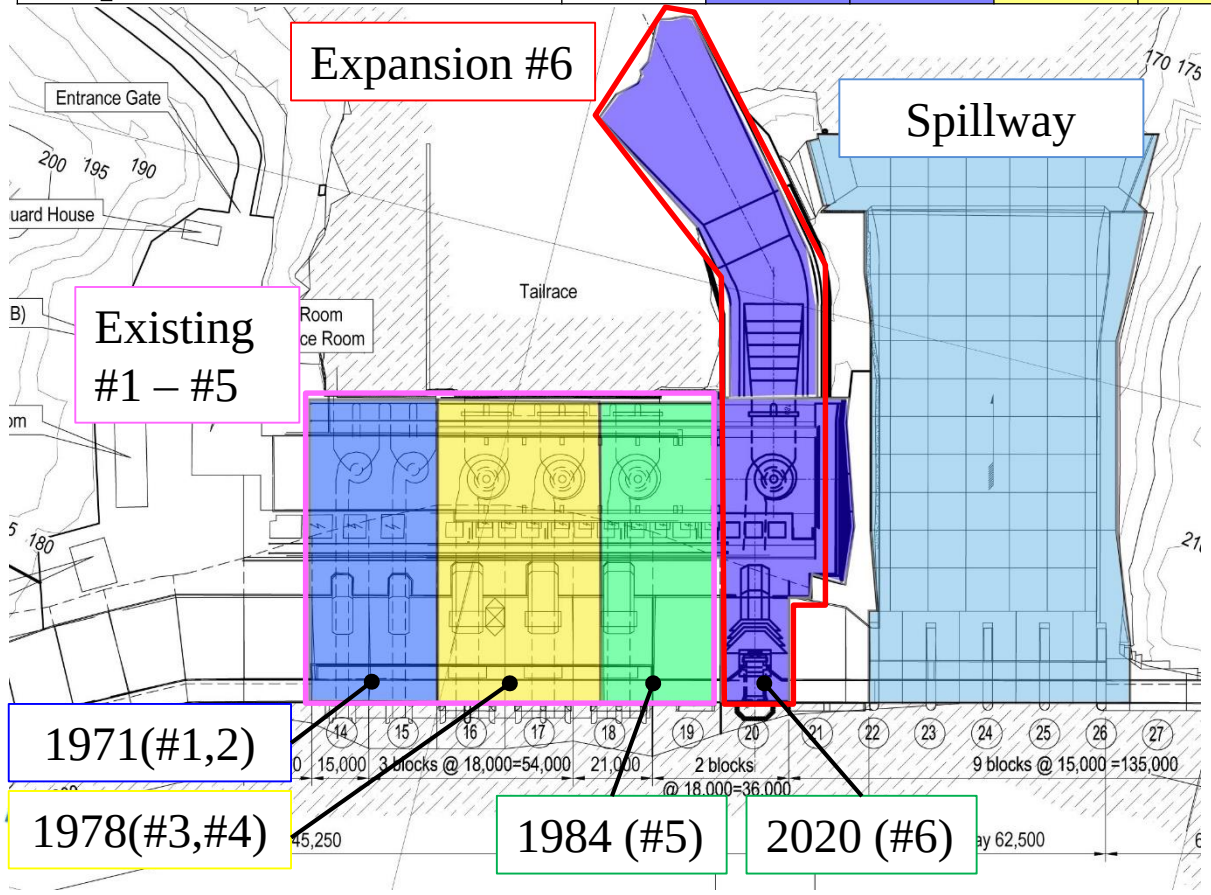


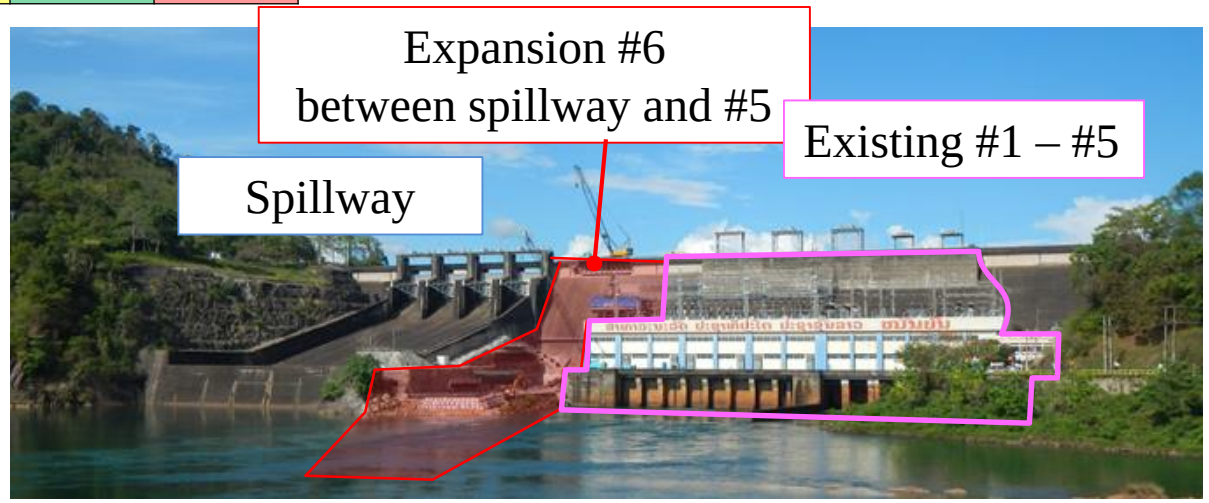
Completion	:	1971
Catchment area	:	8,460 km^2
Gross storage capacity:		7,030 x 10^6 m^3
Reservoir area :		370 km^2
Flood in flow peak:		8,800 m^3/sec
Existing installed capacity (5 units)		:155 MW in total
Dam, Type, Height:		Concrete Gravity, 75 m
Dam volume	:	358,000 m^3

Water storage efficiency (Storage / Dam Volume): 19,600

Nam Ngum 1 Expansion Project

Item	Unit	No.1	No.2	No.3	No.4	No.5	No.6
Effective head	m	35.5	35.5	37.0	37.0	37.0	40.0
Max. Plant Discharge	m^3/s	55.4	55.4	117.1	117.1	117.1	111.2
Output	MW	17.5	17.5	40.0	40.0	40.0	40.0





- Construction Period:
  June 2017 – Nov. 2020 (38 months)
- Finance: JICA
- Contractor: Japanese Firm

Why is it relevant? and What are the benefits?

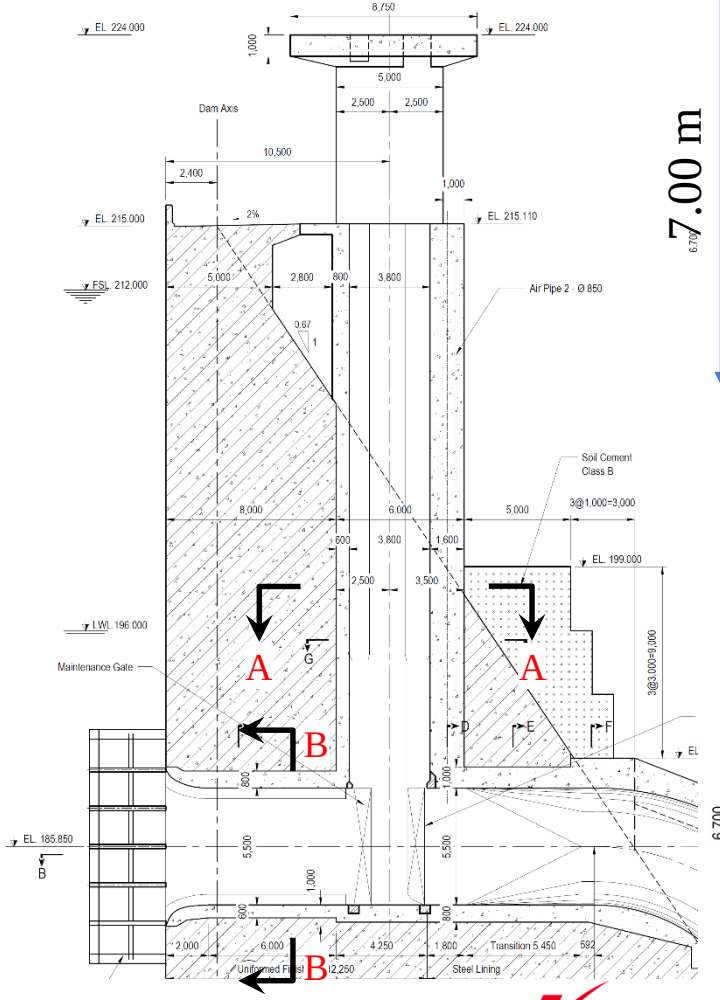
- This technology contributes to reduce costs and environmental impacts, compared with construction of a new dam and reservoir;

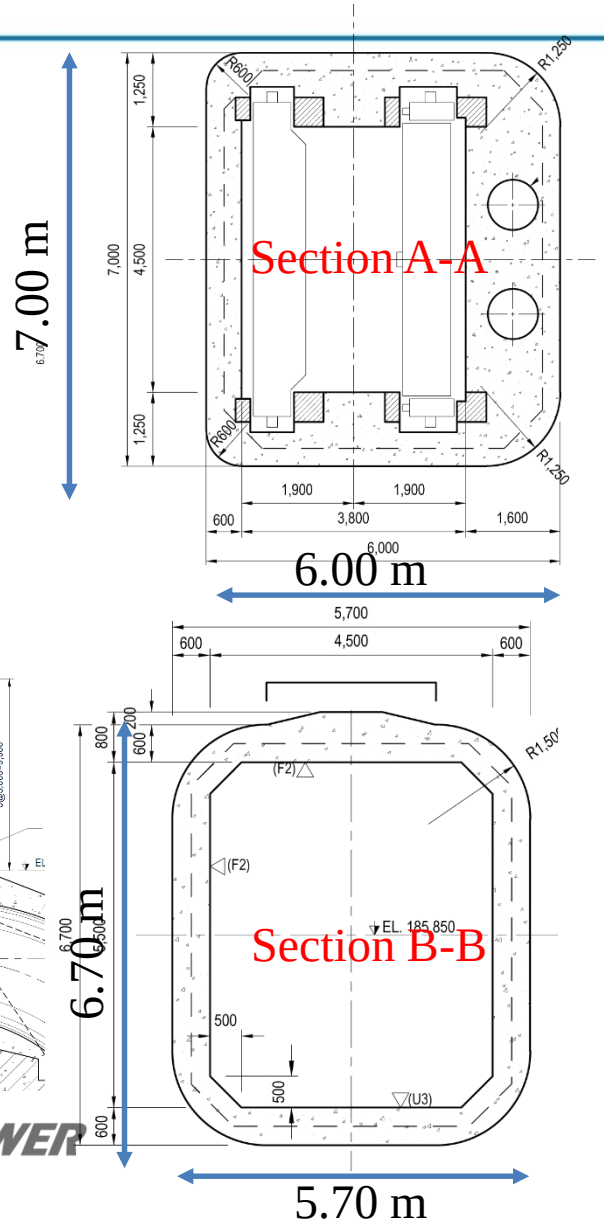
To reduce costs by minimizing waterway length.

To reduce a construction period.

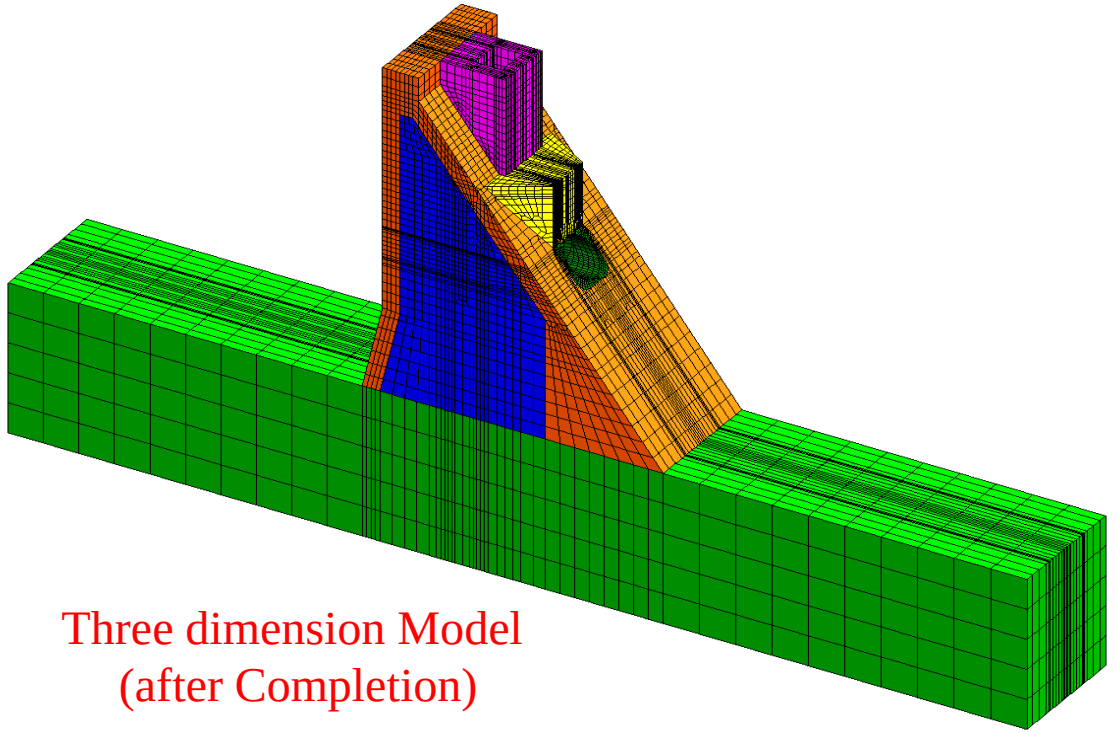
To reduce environmental impacts by arranging the main project components within the existing premises of power utilities concerned.

Design of Dam Piercing





- Stability Analysis of Pierced Dam Body
- Stress Distribution around Piercing (2-Dimensional)
- Stress Distribution around Piercing (3-Dimensional)



Three dimension Model
(after Completion)

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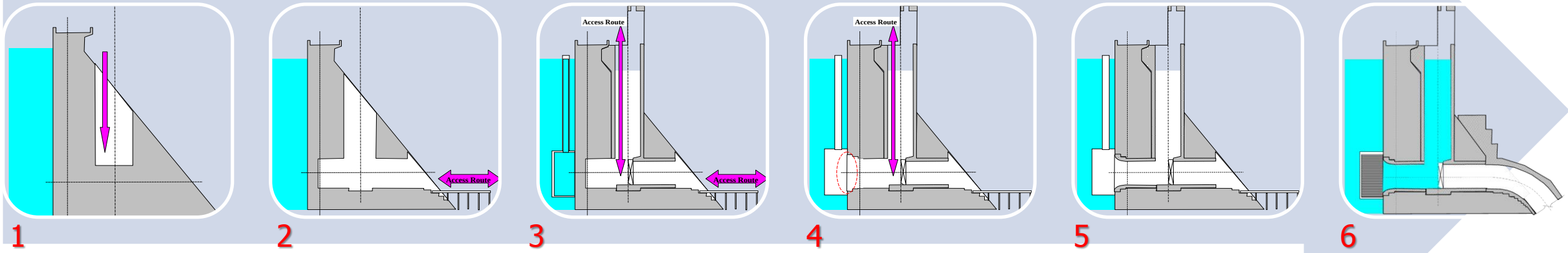
Detail Dam Piercing



- Shaft Piercing (Vertical)[1]
- Adit Piercing (Horizontal)[2]
- Concreting of Gate Shaft and Setting of temporally coffering bulkhead[3]
- Break Through[4]
- Finishing of Interior[5]
- Water Filling[6],
- Removal of temporally coffering bulkhead[6], and
- Setting of Intake Trashrack[6]

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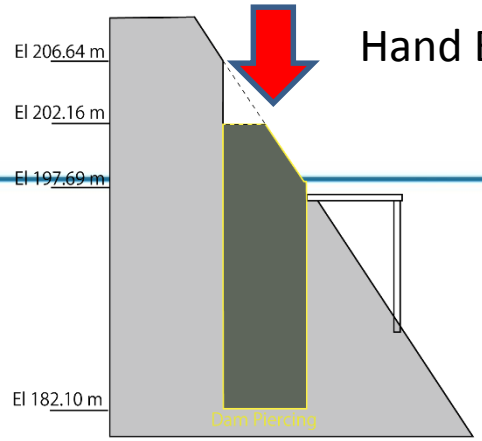
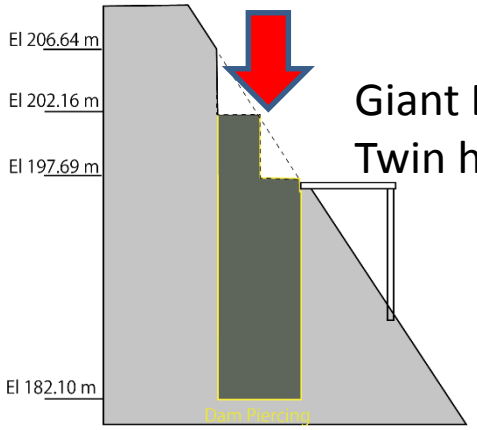
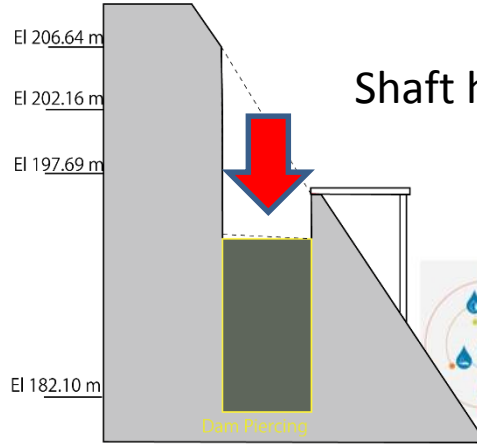
Dam Shaft Piercing



Hand Excavation 1



Giant Breaker and Twin header 2,3



Shaft header 4

ADB

To enable conditions for the innovation and to scale-up application

- What are the required enabling conditions for the innovation?

  This technology requires precise workmanship to prevent negative impact to the existing dam body surrounding the pierced hole as well as to the existing powerhouse and generating equipment under operation. It is important to procure the qualified contractors who have experiences to perform the projects which applied the similar technology.

- What is needed to scale-up application of the innovation?

  Dissemination of information on technology already established for upgrading dam under operation to the authorities concerned of countries in Asia and Pacific Region.

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Status and Plan of the Project