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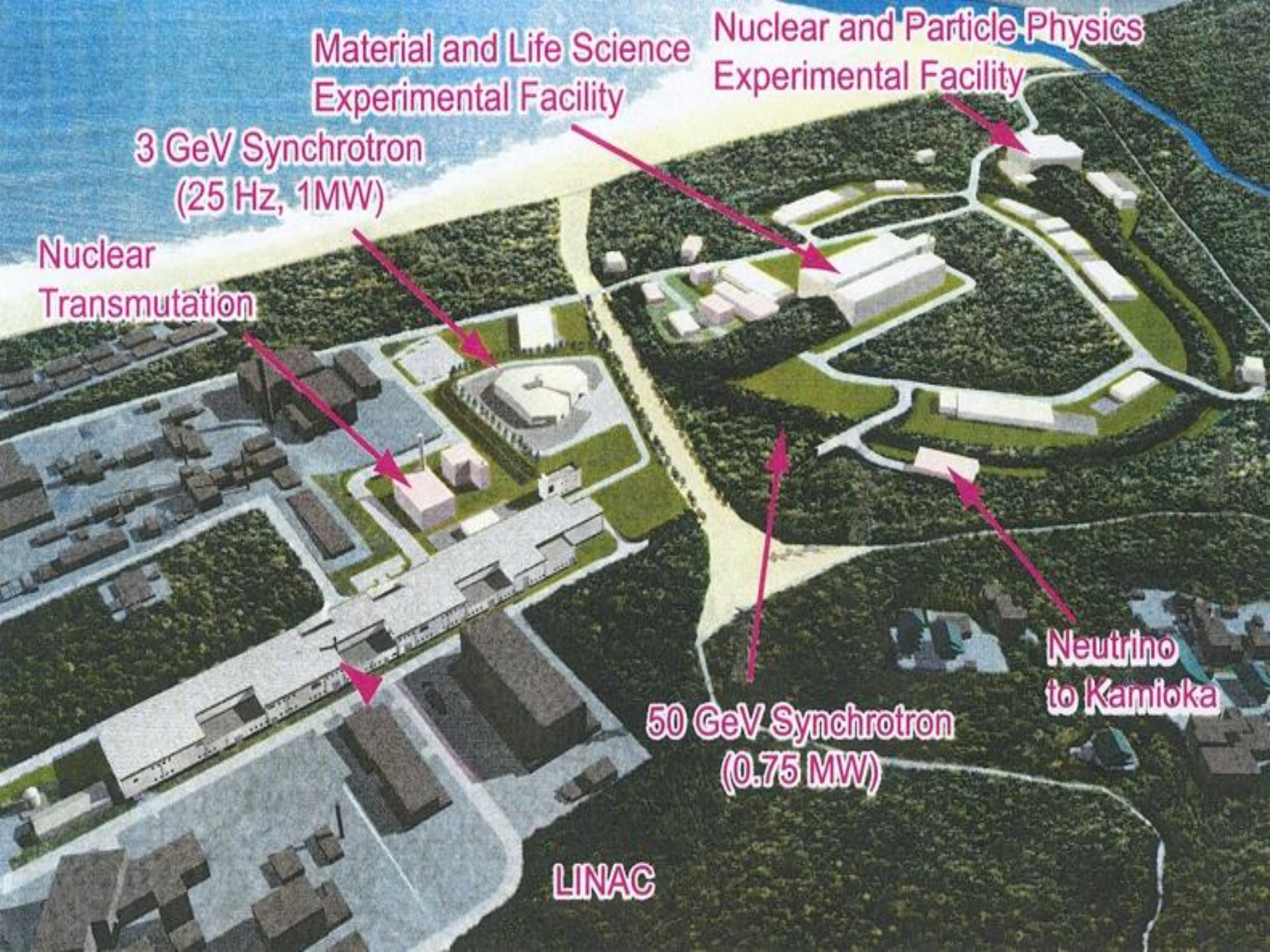
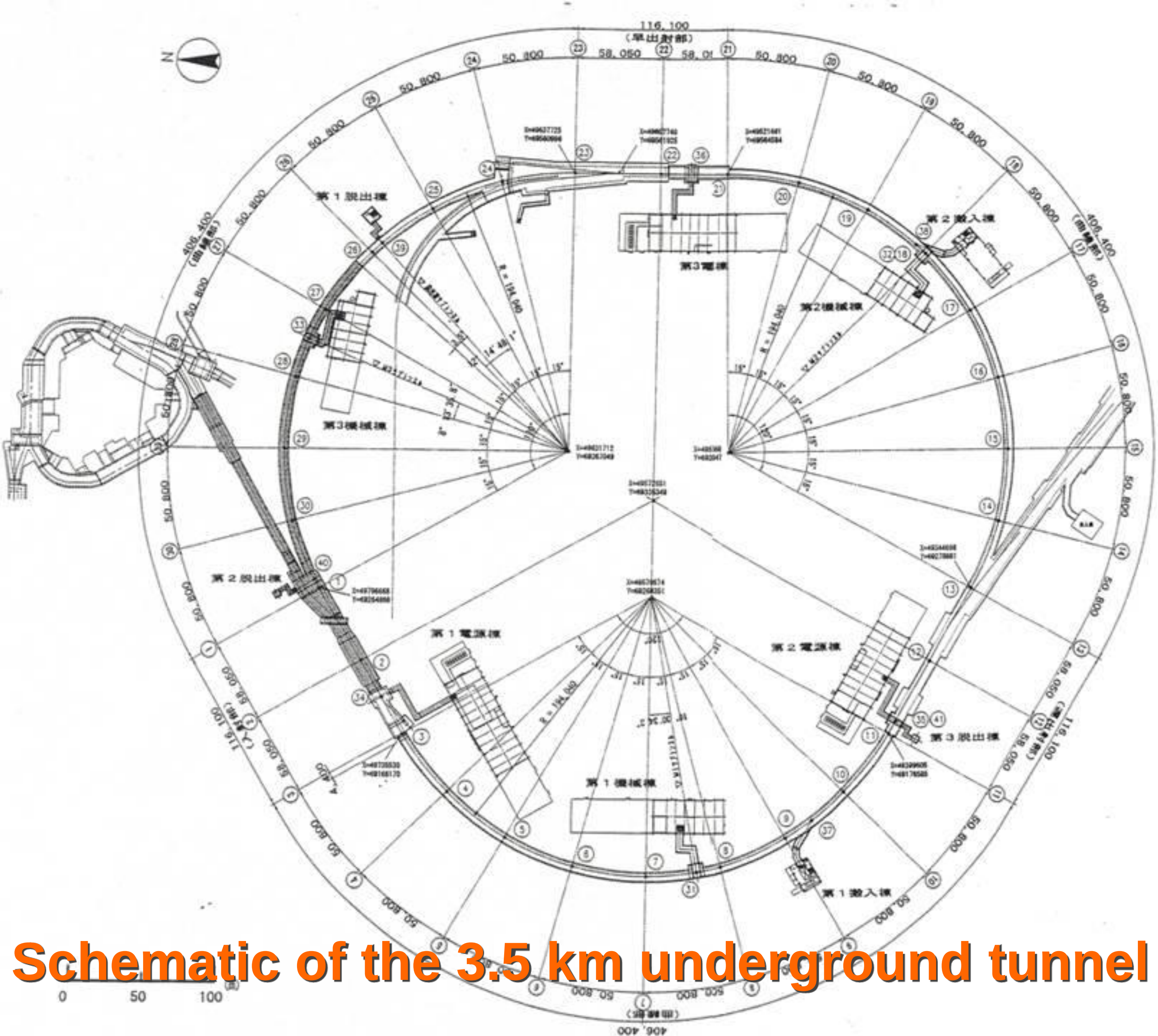
Xypex Applications at J-PARC Synchrotron Project

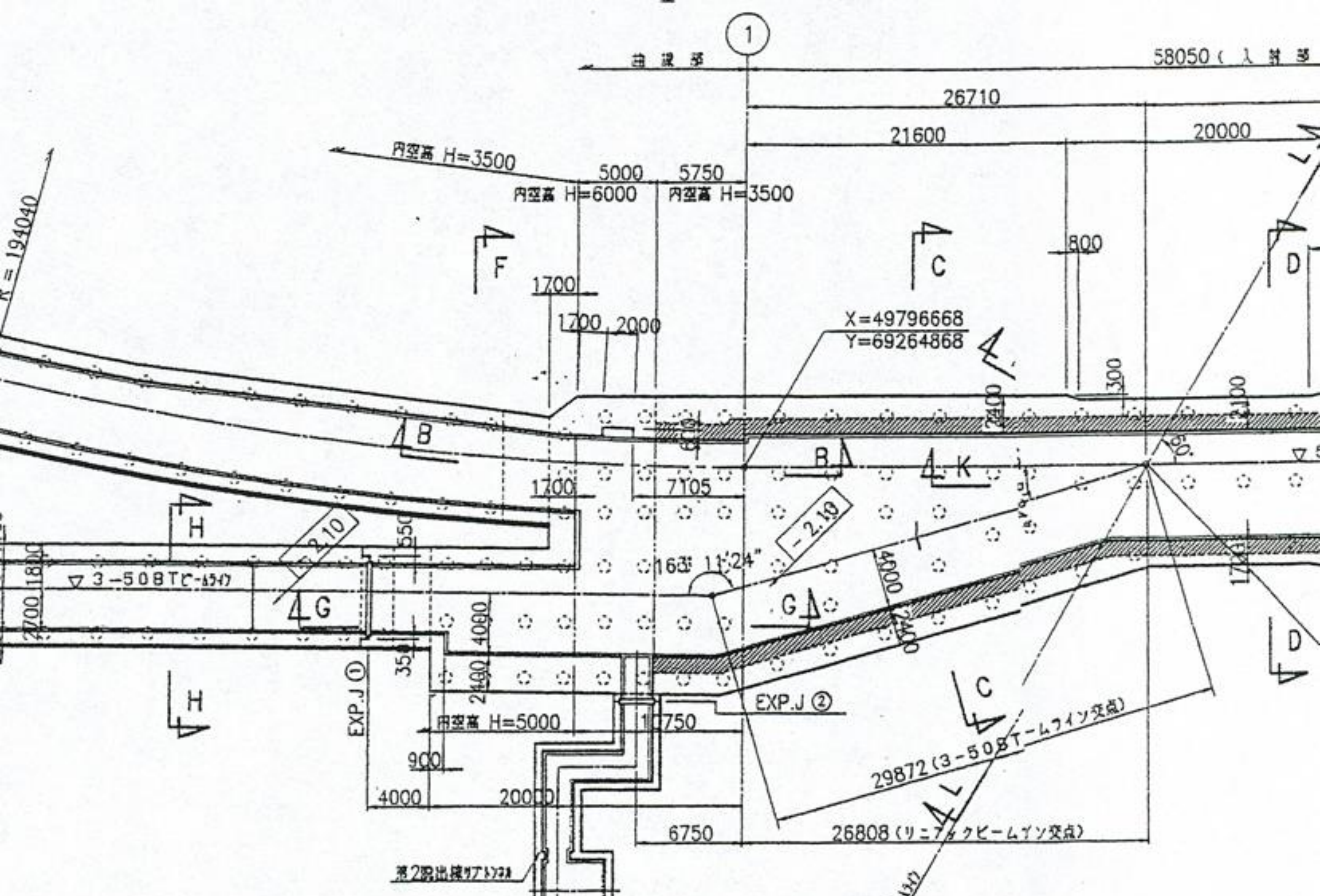
Japan’s Proton Accelerator Research Complex (J-PARC)

Tokai Mura, Japan


Nuclear and Particle Physics
Experimental Facility
Material and Life Science
Experimental Facility
3 GeV Synchrotron
(25 Hz, 1MW)
Nuclear
Transmutation
Neutrino
to Kamioka
50 GeV Synchrotron
(0.75 MW)
LINAC

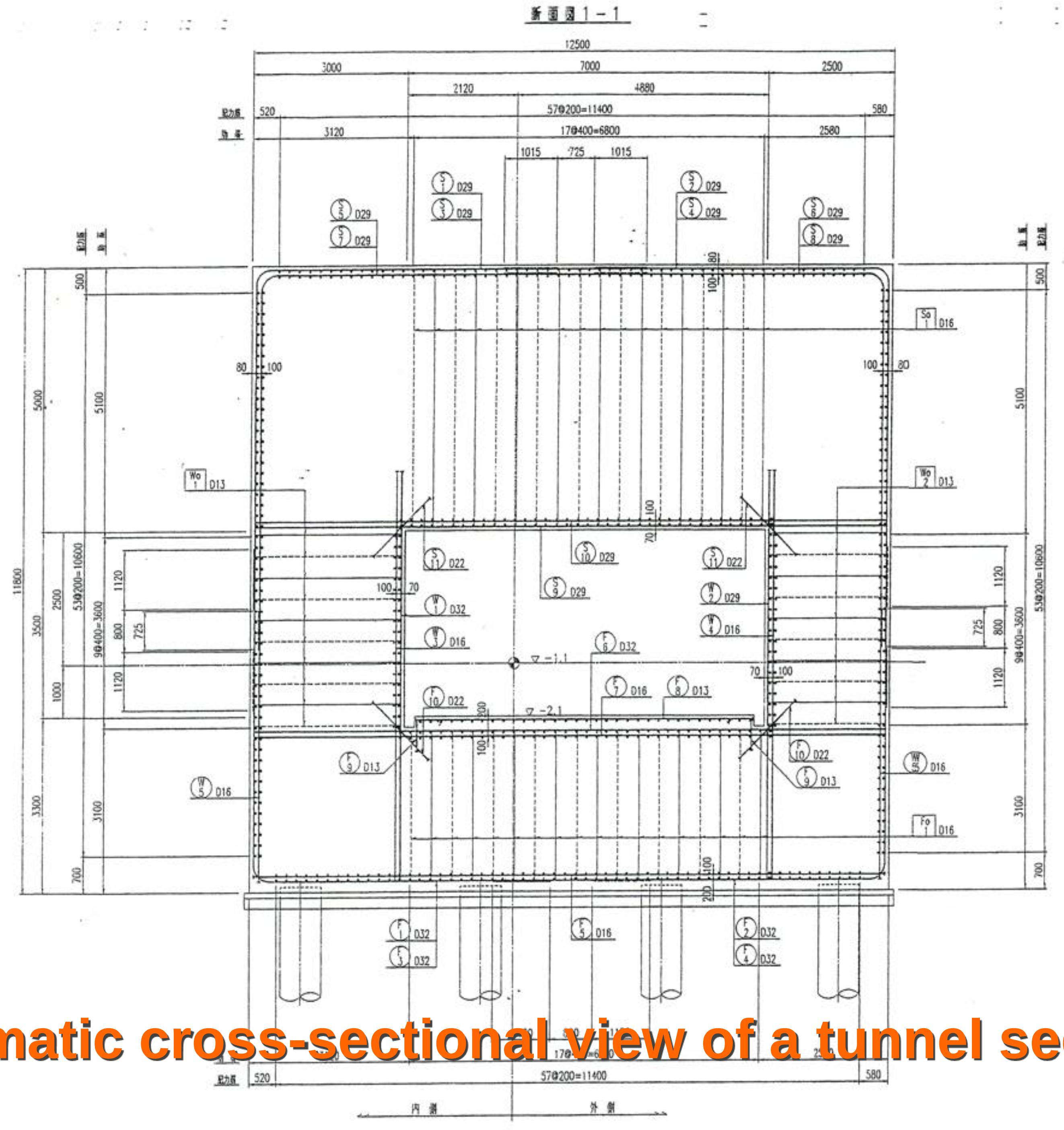


Schematic of the 3.5 km underground tunnel

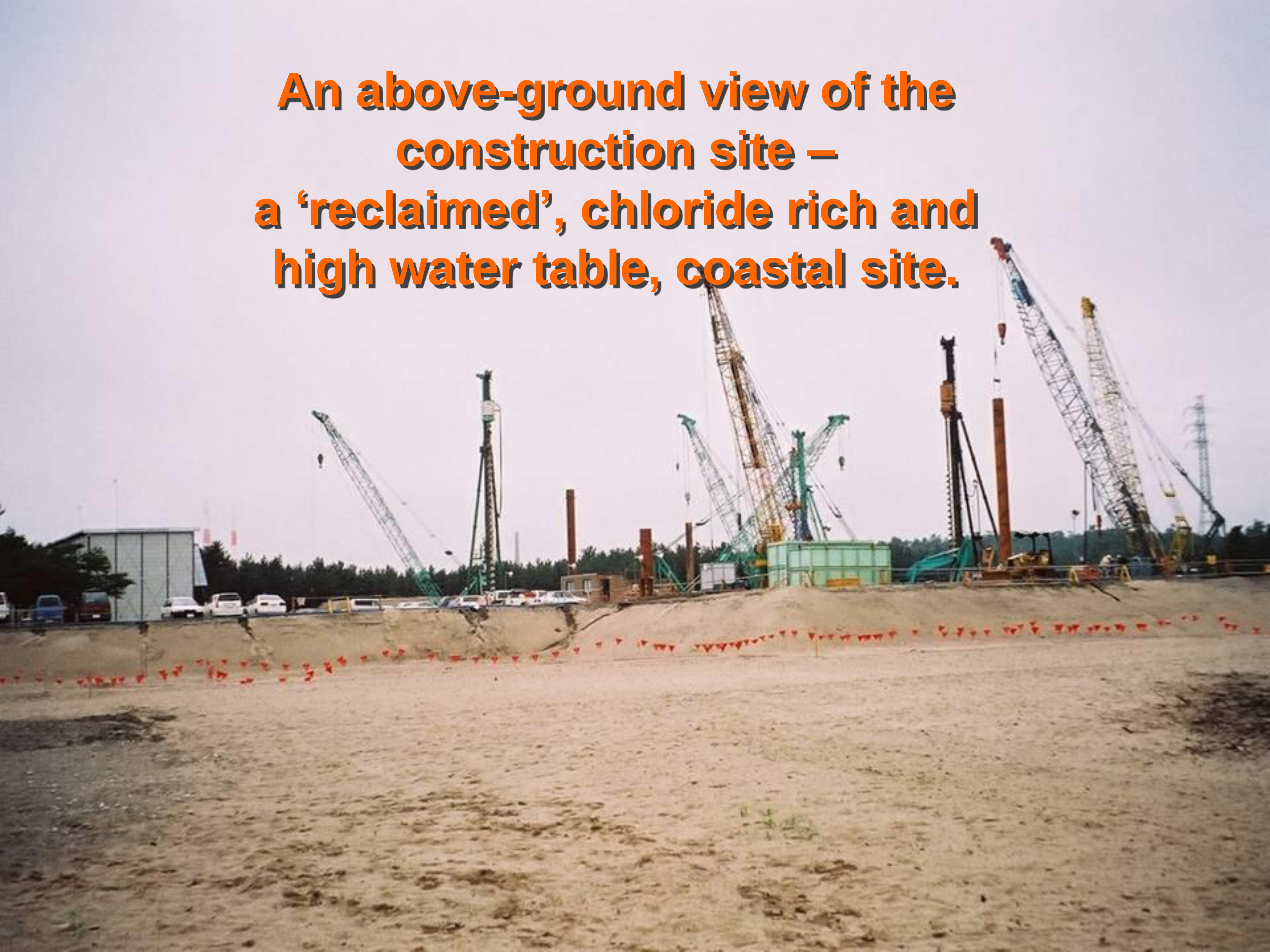


Schematic view of a tunnel section from above

XYPEX



Schematic cross-sectional view of a tunnel segment


An above-ground view of the
construction site –
a ‘reclaimed’, chloride rich and
high water table, coastal site.

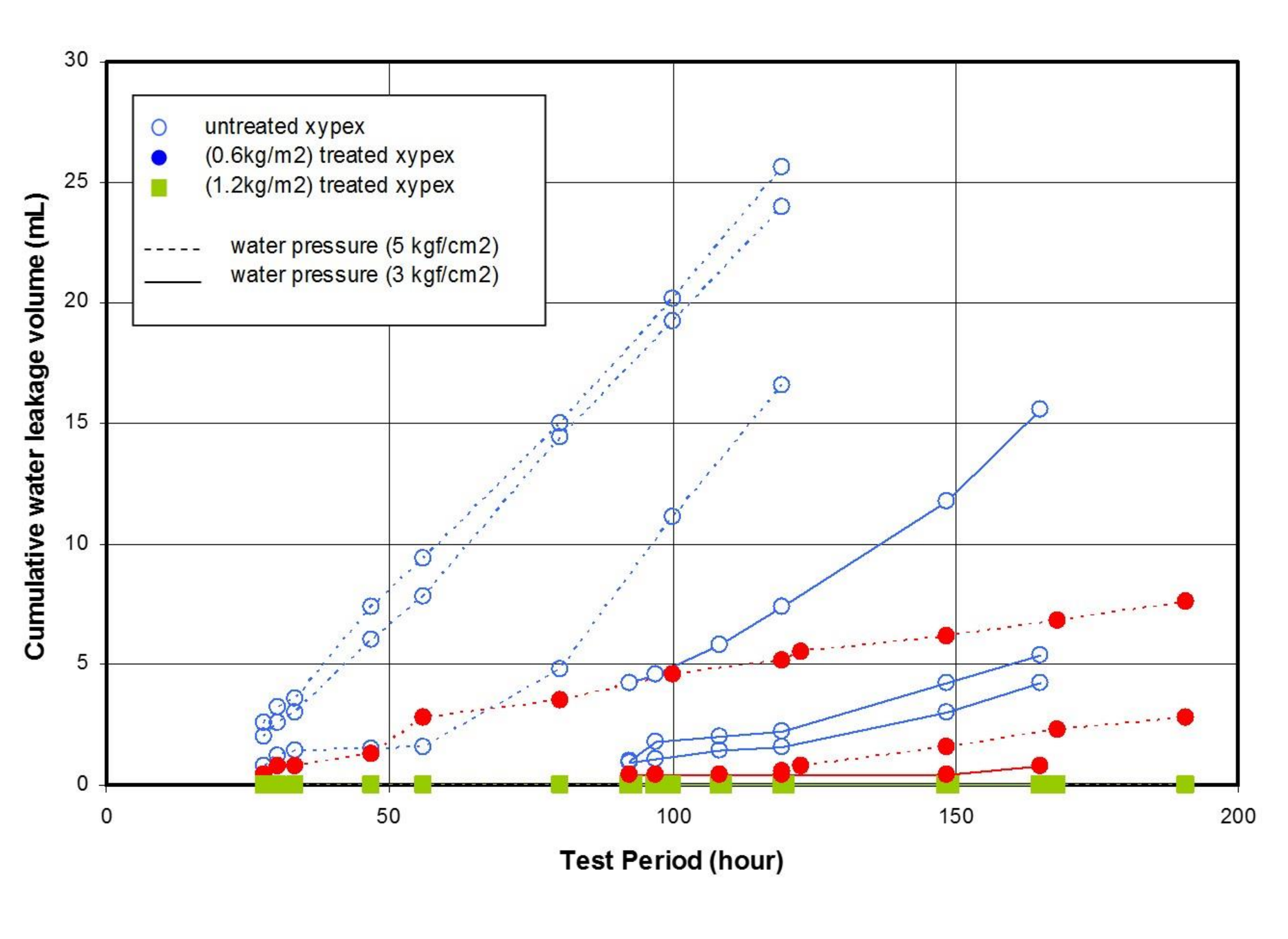
The tunnel during construction

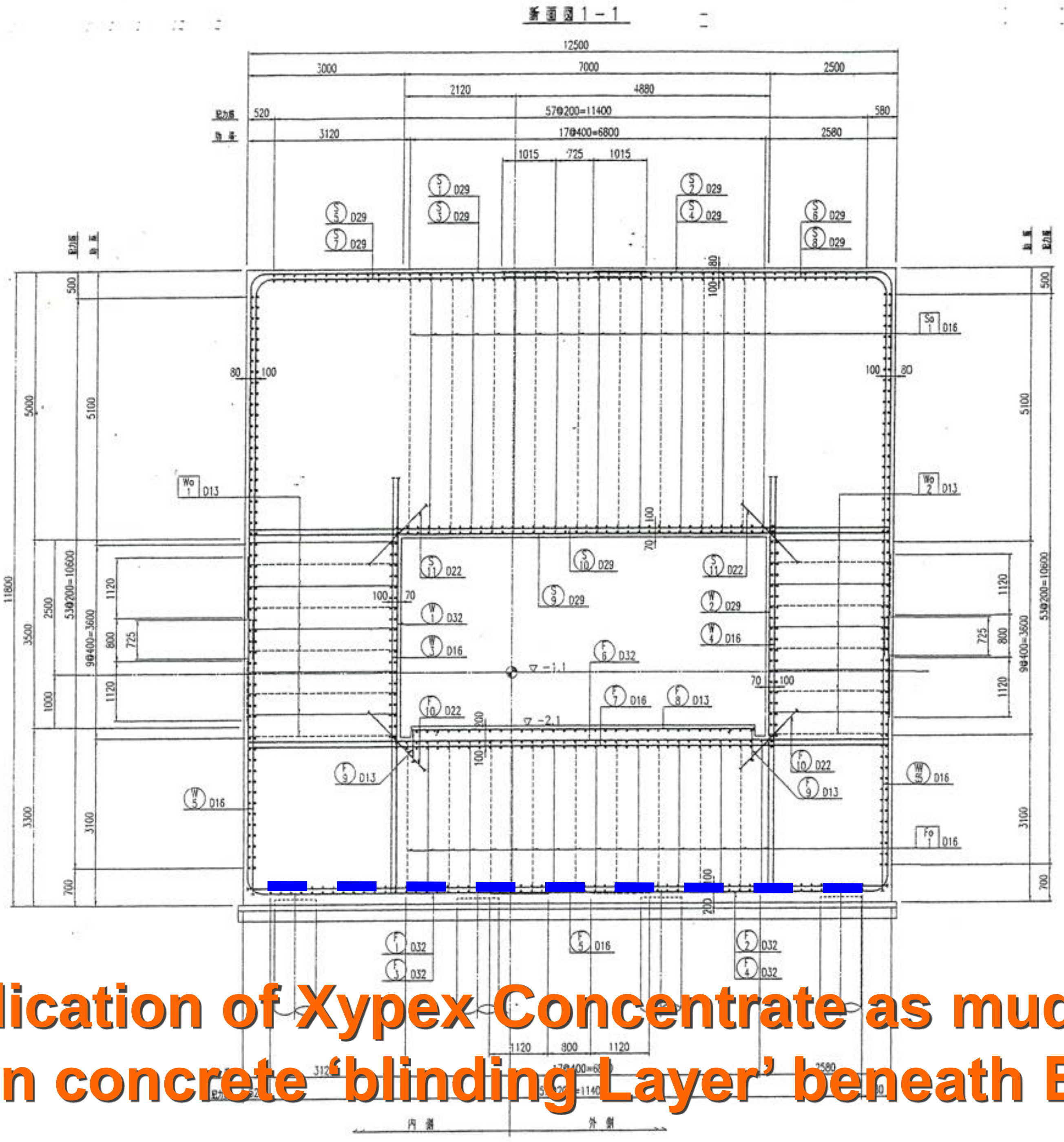
View of base slab and formwork for tunnel walls

Shimizu Construction site offices


On-site meeting with Shimizu engineers,
Xypex and Japan Xypex personnel
XYPEX

Xypex specification was based on JAERI experience and permeability testing results

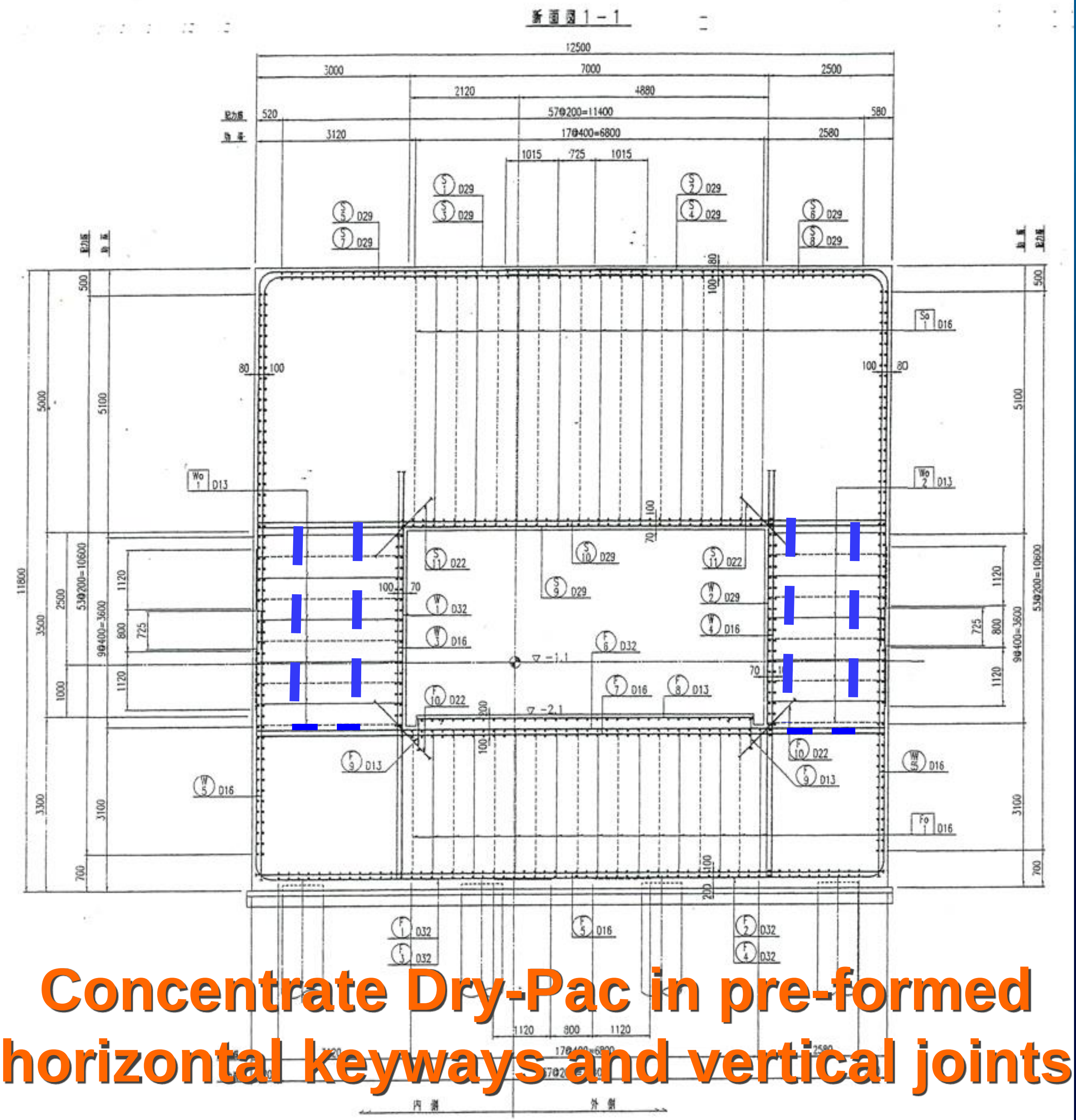




Application of Xypex Concentrate as mud- slurry to lean concrete 'blinding Layer' beneath Base Slab

Application of Xypex Concentrate as mud- slurry to lean concrete 'blinding layer' beneath base slab

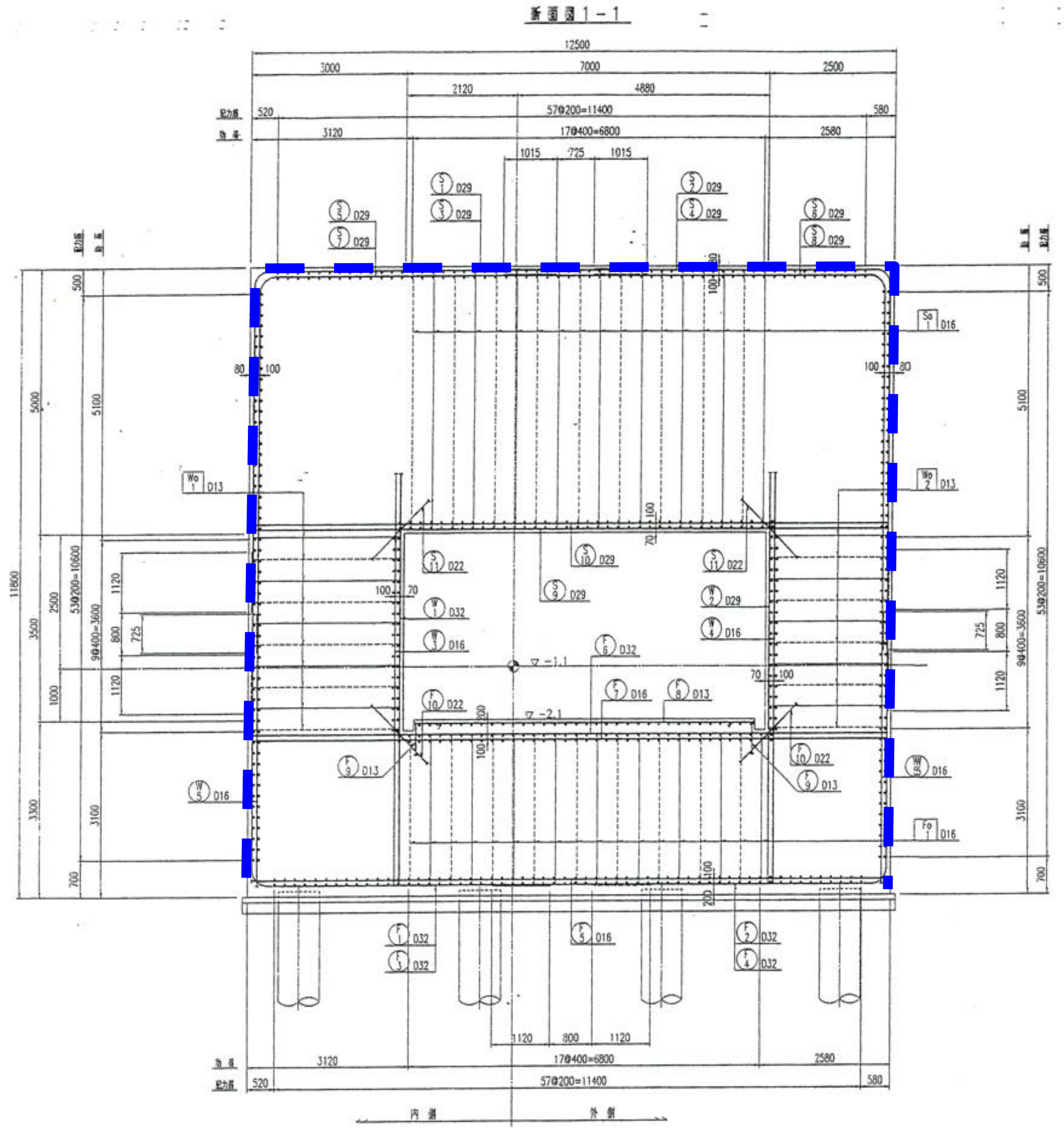
Ready for pouring of base slab

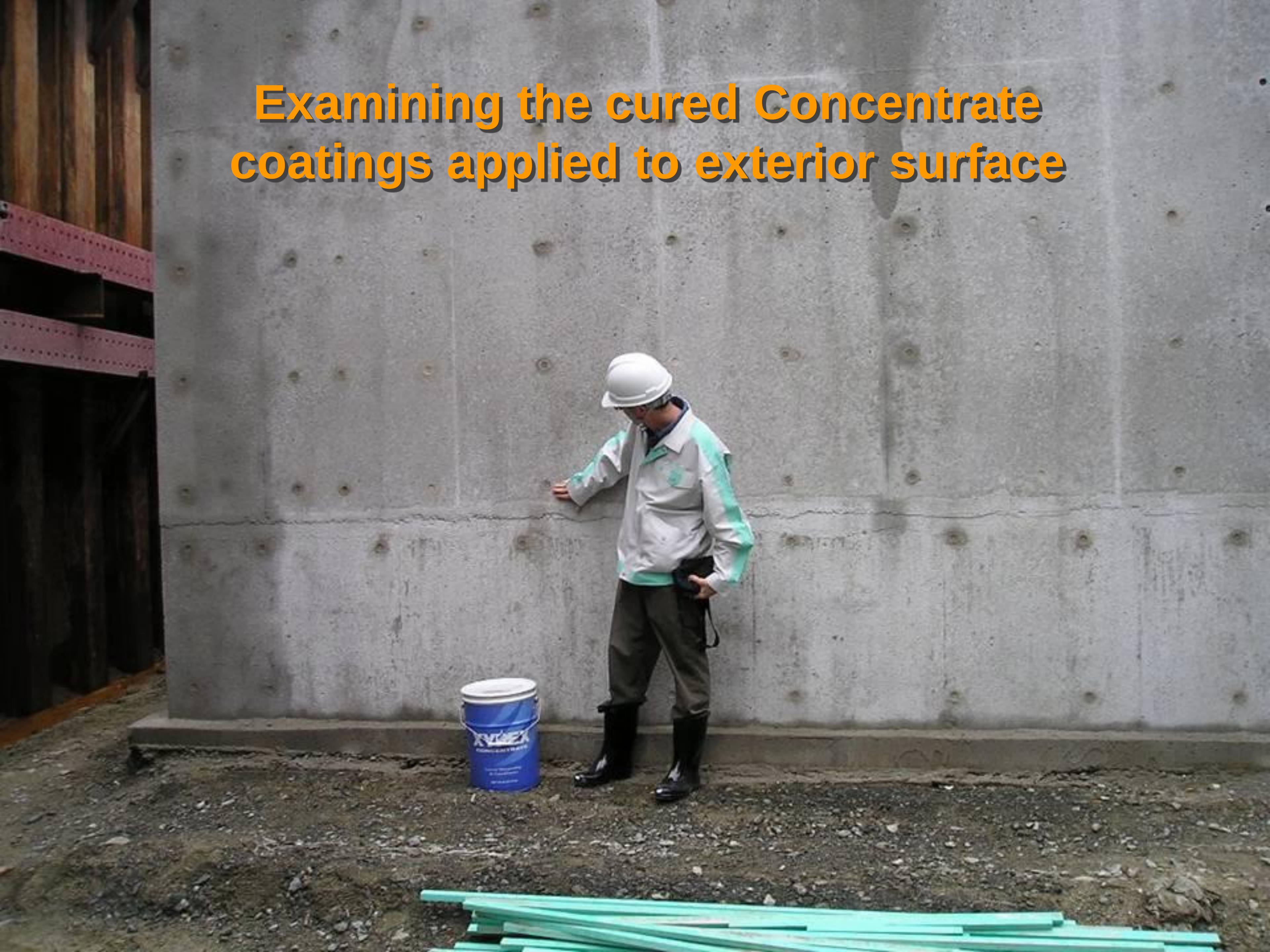


Concentrate Dry-Pac in pre-formed horizontal keyways and vertical joints

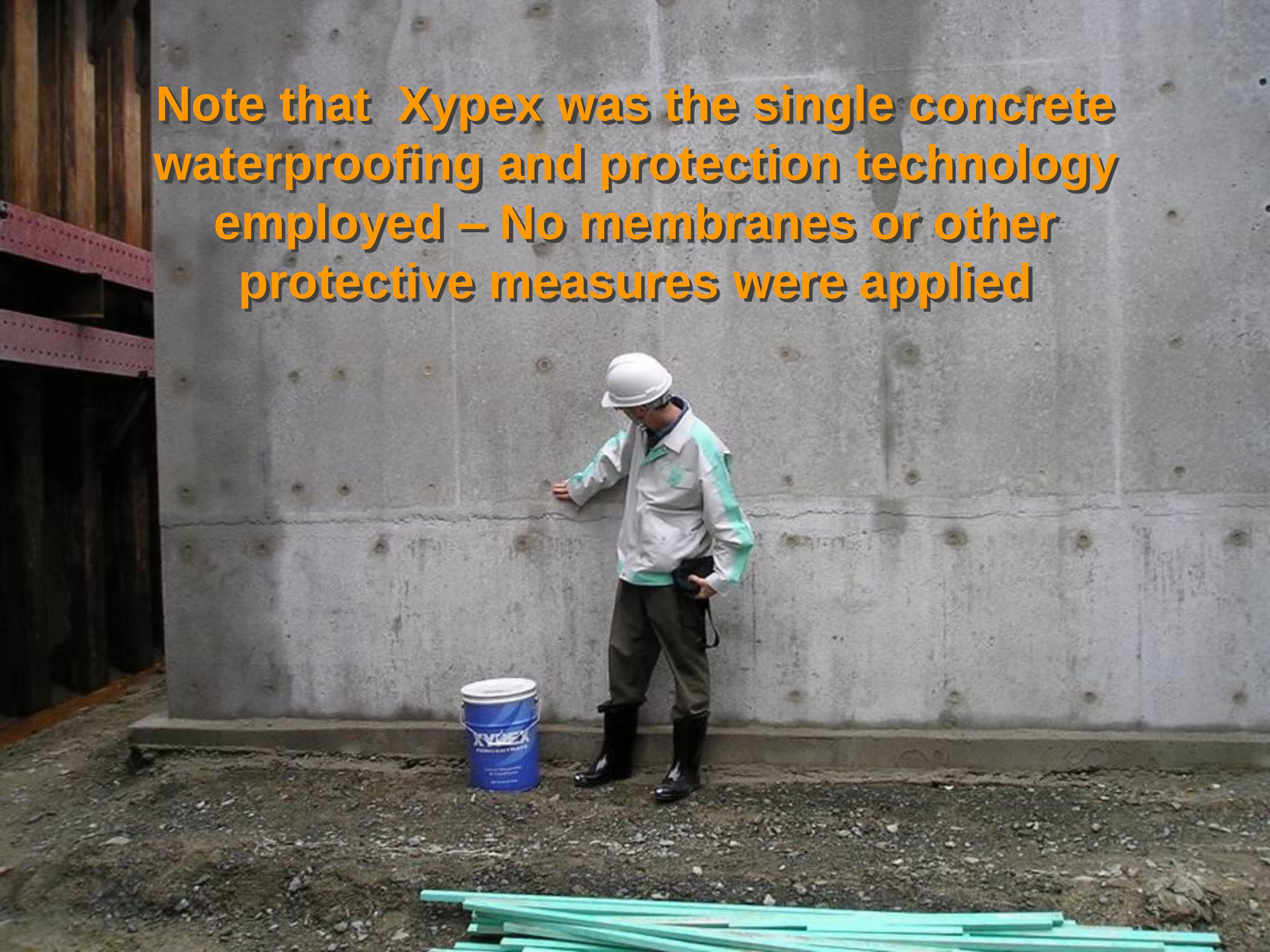
Pre-formed horizontal keyways

Non-expansion, vertical construction joints


断面図 1－1


Examining the cured Concentrate coatings applied to exterior surface

Note that Xypex was the single concrete waterproofing and protection technology employed – No membranes or other protective measures were applied




Inspecting the interior of the
tunnel and repairing defects

Inspecting the interior of the tunnel
and repairing defects


To establish and maintain a 'clean room' environment, all interior surfaces are coated with an epoxy paint

A completed section of tunnel before installation of equipment

Project Statistics

- Over 60,000 kilograms of Xypex Concentrate were applied during construction of this project.
- The total area treated with two coats of Xypex Concentrate was over 50,000 m^2.
- The project was completed in 2007.
- Substantial repairs were carried out to the structure following the damaging earthquake of 2011

感謝状

ジャパン・ザイペックス株式会社殿

貴社は日本原子力研究開発機構及び
高エネルギー加速器研究機構が共同で
建設を進めてまいりました大強度陽子
加速器施設（J-PARC）において優秀な
技術を結集して終始誠意と努力をもって世界
最先端の研究施設完成に貢献されました
本施設の完成記念式典にあたりここに
深く感謝の意を表します

平成二十一年七月六日

独立行政法人 日本原子力研究開発機構
理事長 岡崎俊雄

大学共同利用機関法人
高エネルギー加速器研究機構
機構長 鈴木厚人

J-PARCセンター
センター長 永宮正治

Certificate of Gratitude

(Translation)

To: NIPPON XYPEX CO., LTD.

This hereby certifies our profound gratitude on the occasion of the completion ceremony for the construction of the Japan Proton Accelerator Research Complex (J-PARC), as jointly advanced by the Japan Atomic Energy Agency and the High Energy Accelerator Research Organization. Your contribution offered superior technology together with unfailing sincerity which resulted in a globally leading-edge facility.

6 July 2009

Toshio Okazaki, Director
Japan Atomic Energy Agency, Independent Administrative Agency

Atsuhito Suzuki, Director
High Energy Accelerator Research Organization, Inter-University Research Institute Corporation

Masaharu Nagamiya, Director
J-PARC Center

The following is a statement by

Masanobu Miyahara,
Technical Specialist,
High Energy Accelerator Research Organisation,
KEK Linear Collider Project Office

2nd July 2014

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About waterproofing construction and performance of XYPEX

I had experienced a lot of accelerator construction projects in Japan so far.
Especially for the exterior waterproof of underground structure, I have tried a variety of waterproof materials and construction methods in many big project such as TRISTAN, KEKB, P-Factory, and the long base-line Neutrino Project, etc.

We have learned from the experience of many Accelerator Facility construction in Japan, decided to adopt the "XYPEX" extensively at the J-PARC Project.
And the "XYPEX" respond well to our expectations, and has provided us with the water proofing works of high quality.

I am evaluating especially as follows the point.

- The main material is an inorganic material affinity with the concrete.
- The concrete structure is densified by penetrating into the micro cracks in concrete.
- The large crack in the rare case that also can be repaired from the inside.

J-PARC was under the very difficult site condition of accelerator tunnel construction in a seashore zone of the Pacific-Ocean side.
XYPEX finished the execution in thorough quality control in spite of the severe condition and it was left the excellent results.
KEK laboratory have a special award to honor their achievements with respect to the Japan-XYPEX.

In addition, after the big earthquake that occurred in 2011, it has been made a repair large cracks occur in the concrete.
Also in the restoration work after the great earthquake in 2011,
XYPEX carried out the big contribution.
We will continue to apply XYPEX as an exterior waterproofing construction method of the accelerator facility planning in future project.

2014.7.2

High Energy Accelerator Research Organization,
KEK. Linear Collider Project Office.
Technical Specialist Masanobu Miyahara

<Myself-Introduction>
I belong to the "Linear Collider project office" with KEK as a civil engineer currently.
In addition, I am also a member of the global design team of the "International Linear Collider" project, which is expected to build in the near future in Japan.
During the 2004 from 2009, I took part in J-PARC construction project.
In the project, I was engaged as a person in charge of KEK from the basic design of an underground structure to construction management.

J-PARC (**Japan Proton Accelerator Research Complex**) is a high intensity proton accelerator facility. It is a joint project between KEK and JAEA and is located at the Tokai campus of JAEA.

From: Sadamitsu [mailto:t-sadamitsu@ksg-group.co.jp]
Sent: Wednesday, 2 July 2014 10:31 AM
To: David Lynch
Cc: Chris Miller; 'Jim Caruth'; 笹島 社長
Subject: RE: Most urgent - Chinese CSNS and Japanese J-PARC

Dear Mr. Lynch,

Thank you very much for your mail.

With regard to your question about the past leaking problem in J-PARC facilities, please feel released as we have never received such report or claim before.
The only incident was that J-PARC tunnel was heavily damaged by March 11 earthquake in 2011.
The damage was carefully inspected and NIPPON XYPEX took care of crack repair as well as waterproof treatment.
Needless to say, the cracks were caused by earthquake, not by XYPEX failure.

With regard to your request about a brief letter from J-PARC, we will absolutely try to get one for you.
However please understand that they are not private body and people down there seem to be very busy, often not in the office.
Anyway, since this is very crucial for all XYPEX families, we will try our very best and also as soon as possible.
For your information, we attach a copy of " A letter of Appreciation" given to us in July 2009.

Best regards,
T Sadamitsu

Supplementary Information

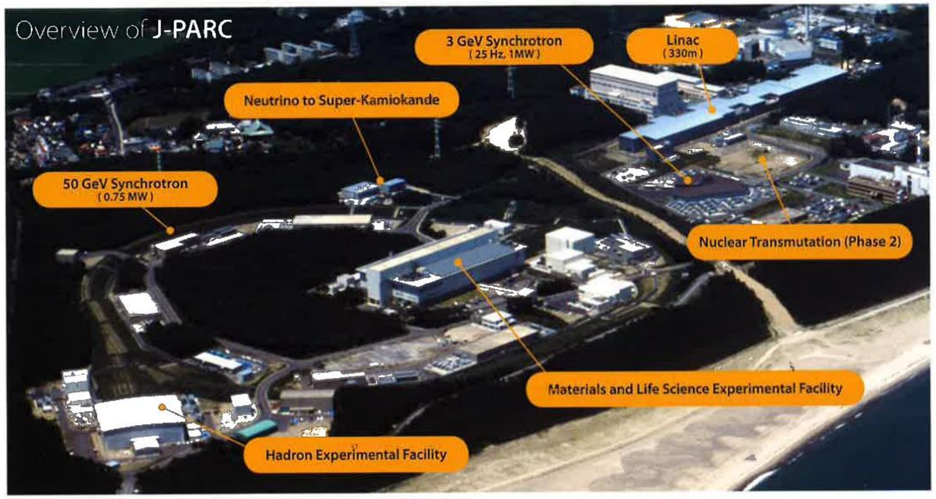
J-PARC
Hadron Experimental Facility

http://j-parc.jp/


J-PARC
JAPAN PROTON ACCELERATOR RESEARCH COMPLEX

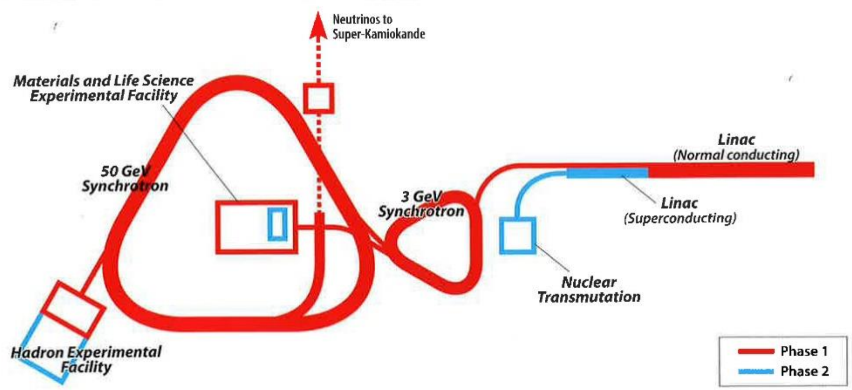
Facilities at J-PARC

The J–PARC stands for Japan Proton Accelerator Research Complex and it is a new and exciting accelerator research facility in Japan. J-PARC has three proton accelerators and three research facilities with using MW-class high power proton beams, which generate neutrons and mesons, to underlie the development of advanced science.



The area of J-PARC is 65 ha (160 acre). It is 14 times as large as a baseball stadium.

Accelerator layout in J-PARC



J-PARC is a joint project between two organizations, High Energy Accelerator Research Organization (KEK) and Japan Atomic Energy Agency (JAEA). The facility is located in Tokai village in the northern region of Ibaraki prefecture, JAPAN.

Construction started in April 2001, and in the spring of 2009 (end of JFY2008) the Phase 1 project was completed after eight years of construction period.

Science at **J-PARC**

Our universe has a hierarchic structure of matter. For example, all of materials are consist of atoms. Atoms can also be divided into atomic nuclei, and nuclei be divided into nucleons (protons and neutrons), and finally quarks. Naturally, many questions come to mind: "How did the dawn of life occur from collections of atoms?", "What are the extreme constituents of matter?", etc.

J –PARC will throw light on the mysteries of the creation and structure of our universe by investigating matters at all levels, from quarks to atoms, with using various kinds of particle beams.

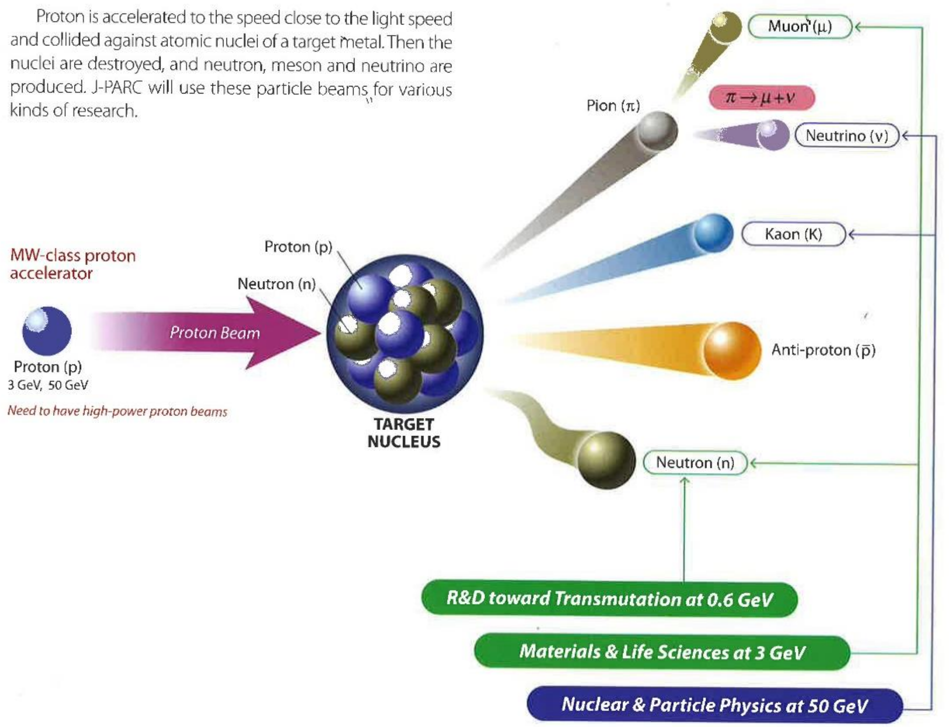
The usage of various secondary particle beams (neutrons, muons, kaons, neutrinos, etc.) that are produced in proton-nucleus reactions (nucleus spallation) is the prime purpose at the J-PARC.

With these secondary particle beams, three major scientific goals will be attained:

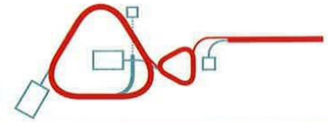
- nuclear particle physics
- materials and life sciences
- R&D for nuclear transmutation (later, in Phase 2)

Secondary beams produced with high-intensity proton beam

Proton is accelerated to the speed close to the light speed and collided against atomic nuclei of a target metal. Then the nuclei are destroyed, and neutron, meson and neutrino are produced. J-PARC will use these particle beams for various kinds of research.



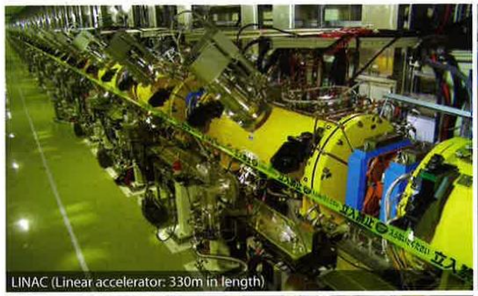
Accelerators of J-PARC



The J-PARC consists of the following accelerators:

- 400-MeV linear accelerator (Linac). It is about 330m in length.
- 3-GeV rapid-cycling synchrotron (RCS), which provides proton beams at 333μA (1MW). It is about 350m in circumference, and can accelerate protons up to about 97% of light speed.
- 50-GeV synchrotron, which provides proton beams at 15μA (0.75 MW). It is about 1600m in circumference, and can accelerate protons up to about 99.98% of light speed.

(Phase 2, we have a plan for construction of superconducting Linac, to increase the energy from 400 to 600-MeV)


LINAC (Linear accelerator: 330m in length)

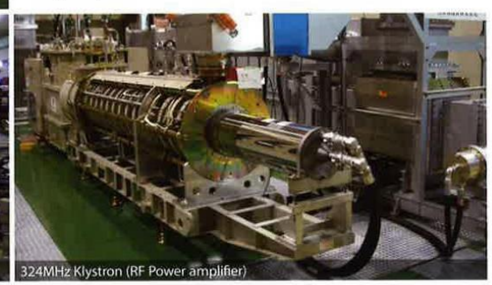

3GeV synchrotron (It is 350m in circumference)


50GeV synchrotron (It is 1600m in circumference)

Many new technologies have been invented and developed for the J-PARC accelerator. As accelerators are a precision machine, they are installed within a tolerance of 0.1 mm. All of J-PARC accelerators are placed in the tunnel established underground. The tunnel is made with thick steel-framed reinforced concrete.

The proton speed is very important for nucleus spallation, thereby producing neutrons and mesons to be used in study. The RF (radio frequency) accelerating system is used for the acceleration. Finally, the proton beam is accelerated nearly to the light speed.

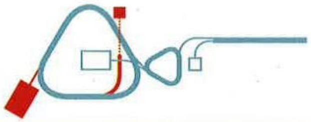

RF Cavity


324MHz Klystron (RF Power amplifier)

Why J-PARC's synchrotron is not a precise circle, but a triangle with having rounded corners?

Synchrotron accelerator is a round type accelerator. Many large electromagnets are set to bend and squeeze the proton beam. Note that J-PARC's synchrotron is a triangle with having rounded corners. The reason why we have this shape is that it is necessary to get the proton beam in and out from the accelerators through a linear part. There is one inlet and two outlets for 50GeV synchrotron for the proton beam, thus, these three linear lines make a triangle.

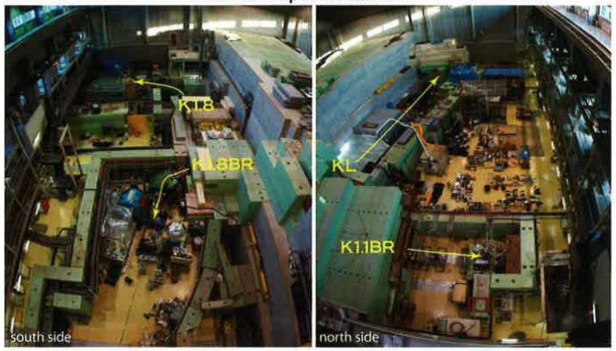
Nuclear and Particle Physics Facility



At the 50GeV Synchrotron, nuclear and particle physics experiments are performed using high-intensity beams such as the kaon beam, pion beam, neutrino beam as well as the primary proton beam.

In these research fields one looks for answers to the very fundamental questions such as;"What are the extreme constituents of matter?", "What are the fundamental interactions or forces acting between particles?" and "What is the origin of mass of elementary particles?" In order to study these questions, the experiments with high precision, with very new phenomena or with exotic states will be pursued using the high-intensity beams.

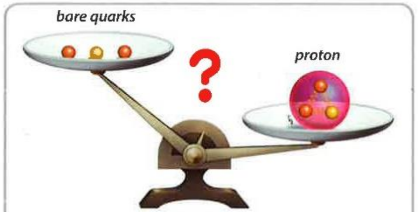
Hadron Experimental Hall



The Hadron (Hadron; an aggregate of quarks) Experimental Hall uses the slow extracted proton beam from the 50GeV Synchrotron. There are several secondary beam lines, where secondary particles, such as pions (pi mesons) and kaons (K mesons), produced at the production target are transported for experiments.

Studies on "hyper-nuclei", nuclei with "strange" particles inside, are being conducted at the K1.8 beam line using kaons, whose goal is to understand the fundamental interactions between hadrons.

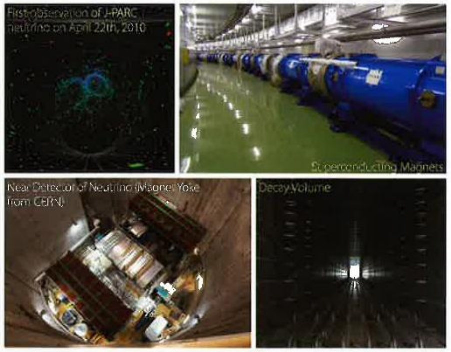
Rare kaon decays are studied at the KL beam line to investigate the so-called "CP violation", a key to understand our universe where matter dominates over anti-matter. An experiment is planned with the proton beam to investigate the origin of the hadron mass.



Why is a proton, which consists of 3 quarks, 100 times heavier than the sum of 3 bare quarks?

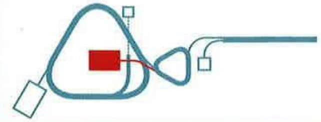
T2K experiment

Tokai to Kamioka (T2K) is a Japanese-led multinational physics experiment. High-intensity neutrino beams are directed from the J-PARC at Tokai village towards Super-Kamiokande the world's largest underground neutrino detector—located in Hida city, Gifu Prefecture. As the neutrinos traverse the Japanese Archipelago at virtually the speed of light, a change occurs in an essential characteristic—the generation or flavor—of the neutrinos. This phenomenon is known as neutrino oscillation. By investigating neutrino oscillation, we can uncover the mysterious characteristics of neutrinos. In particular, we can determine their relative lightness, as compared to other elementary particles such as electrons or quarks, and also the extent of mixing of neutrino flavors. These are fundamental issues in the field of elementary particle physics, which may provide the key to understand the evolution of our matter-dominated universe.



Neutrino traveling long-distance from J-PARC to Super-Kamiokande

Materials and Life Science Experimental Facility



Mercury Target for Neutrino Production

Extensive scientific programs covering condensed-matter physics, materials sciences, industrial applications, structural biology and nuclear/particle physics, will be carried out at the Materials and Life Science Experimental Facility (MLF).

The MLF provides the world's highest flux of neutrons and muons by proton-impact nucleus spallation reactions with a 3GeV proton synchrotron of 1MW beam power. The proton beam cascades the graphite target for muons and reaches to the mercury target for neutrons. 23 neutron beam lines and 4 muon beam lines are planned and will be installed in the MLF building. Synergetic use of neutrons and muons at the world's highest flux will be enabled at MLF, where will be a center of materials and life science researches.

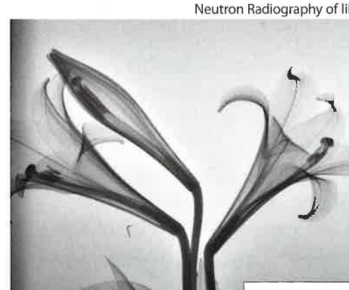
MLF #1 Experimental Hall

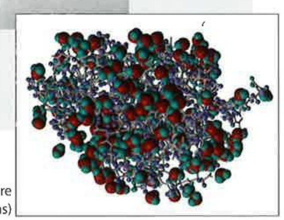
MLF #2 Experimental Hall

Neutron Beam Line #19 "TAKUMI"

Since the neutron has a mass that is similar to that of the hydrogen atom, a magnetic moment but no electric charge, and a high penetrating power, the neutron can sensitively probe spin correlations, and the location and motions of atoms, especially hydrogen atoms, in materials. These characteristics of the neutron make neutrons play crucial roles in many subjects like studies of the locations and motions of hydrogen atoms in biological cells, which is of particular interest in life science.

Neutron Radiography of lily

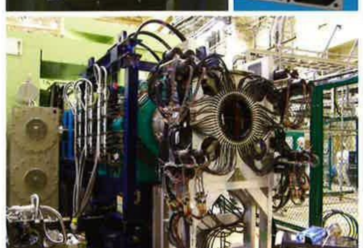




Hen Egg-White Lysozyme Structure
(Water molecules observed with neutrons)

Muon target

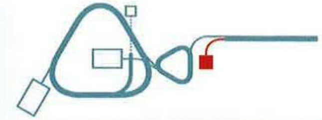
Hard disk



Muon beam line

The positive muon (μ+) behaves as a light radioisotope of the proton in matter. Because of its large magnetic moment (up to three times that of proton), implanted positive muons have a wide variety of applications to materials science and biology in a fashion similar to nuclear magnetic resonance (μSR). Even more importantly, the μSR technique provides truly complementary information to that obtained from neutron diffraction on the same object.

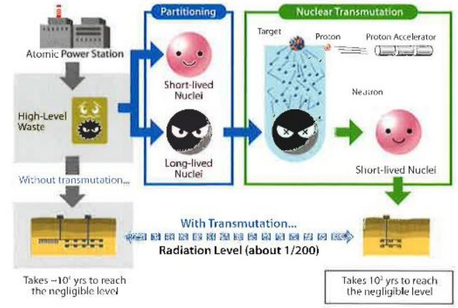
Transmutation Experimental Research (Phase 2)



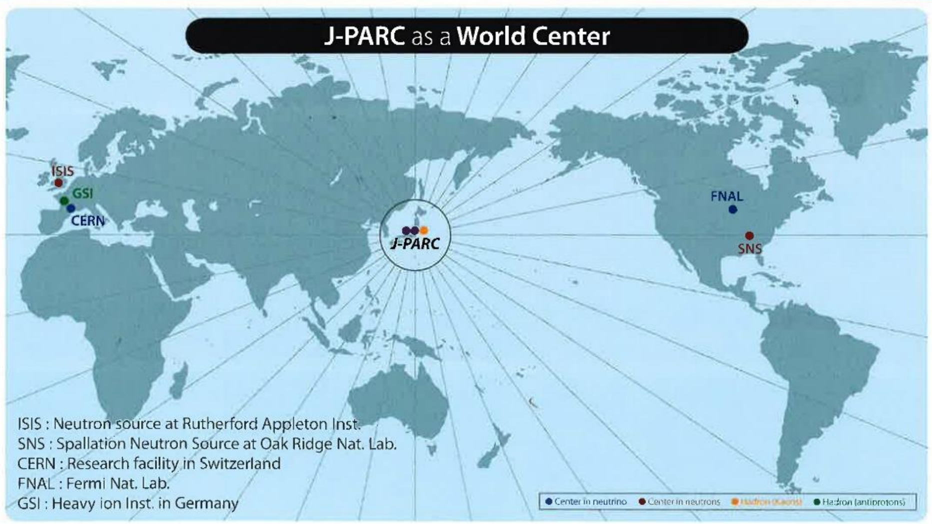
Nuclear transmutation is a physical phenomenon where a target nuclide transmutes to another one by a nuclear reaction. In the present fuel cycle system for commercial nuclear power plants, the reprocessing of the spent fuels produces High-Level Nuclear Wastes (HLWs) including long-lived nuclides.

If the long-lived nuclides can be converted to short-lived or stable ones by the transmutation technique, the management period for geological disposal of HLWs could be much shorter than expected, and this leads to a reduction of the burden of geological disposal.

At phase 2, J-PARC plans to construct the Transmutation Experimental Facility (TEF) for the basic study of radioactive waste management. J-PARC will contribute to basic research and development of transmutation technique.



Nuclear Transmutation experiment



J-PARC is used by researchers and scientists from all over the world. Many domestic and overseas researchers gather and use it for their study. J-PARC will be a world center of science research.

For the purpose of their easy access and convenience, Users Office and laboratory offices are provided in Ibaraki Quantum Beam Research Center, which is near J-PARC.

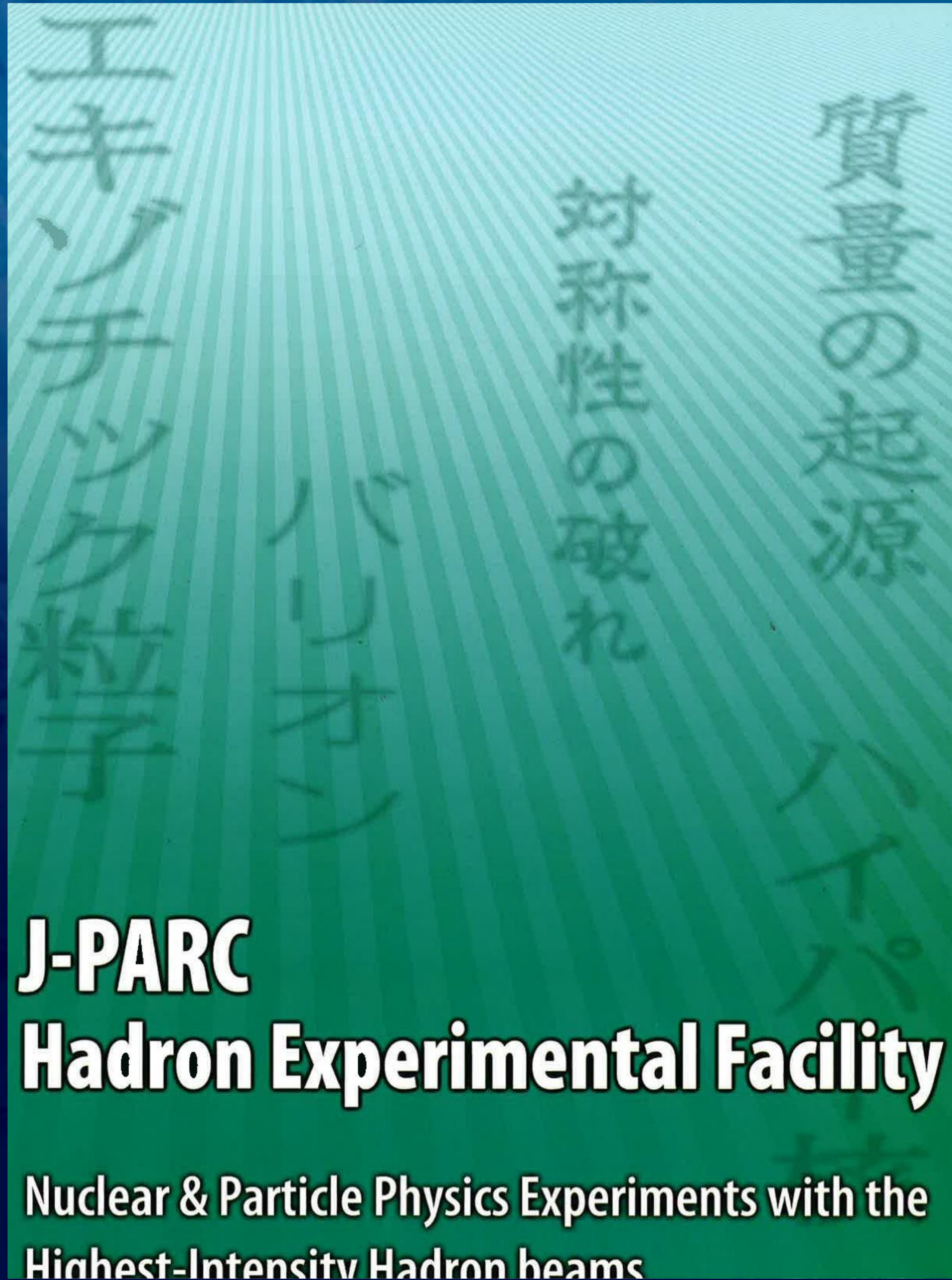
We believe that J-PARC will contribute to obtain the most-advanced science and technology, which resulting to the development and prosperity of humankind in the future.

KEK / JAEA J-PARC Center

2-4 Shirane Shirakata, Tokai-mura, Naka-gun, Ibaraki 319-1195, Japan

High Energy Accelerator Research Organization (KEK)
1-1 Oho, Tsukuba, Ibaraki 305-0801, Japan

Japan Atomic Energy Agency (JAEA)


質量の起源
ハイパ
対称性の破れ
バリオン
エキゾチック粒子
J-PARC
Hadron Experimental Facility
Nuclear & Particle Physics Experiments with the
Highest-Intensity Hadron beams

XYPEX


Long-baseline Neutrino Oscillation Experiment
東海−神岡間
長基線ニュートリノ
振動実験
T2K
Tokai to Kamioka
J-PARC
Neutrino Experimental Facility
(KEK-JAEA, Tokai)
295km
日本
長野県
N37
長岡
栃木県
神栖
茨城県
J-PARC
日立
新潟県
新潟
E141°
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Super-Kamiokande


XYPEX®
The World Standard in Concrete Waterproofing by Crystallization™
Concrete
(Untreated)
Xypex Crystallization
(Initiated)
Xypex Crystallization
(Mature)
When you select Xypex, you've chosen the best: more than 40 years of independent testing of our original crystalline technology... and still *no equal*; our many years in over 70 countries have made us specialists; our unmatched product and service standards provide confidence and peace-of-mind to architects, engineers, contractors and concrete producers serious about long-term concrete waterproofing, protection and durability.
1.800.961.4477 | xypex.com
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