JINR Dubna site proposal for ILC

G.Trubnikov

Joint Institute for Nuclear Research

Sendai, March 2008

International Intergovernmental Organization

Joint Institute for Nuclear Research

Joint Institute for Nuclear Research: International Scientific Centre

BİRLƏŞMİŞ NÜVƏ TƏDQİQATLARI İNSTITUTU

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АБ'ЯДНАНЫ ІНСТЫТУТ ЯДЗЕРНЫХ ДАСЛЕДАВАННЯЎ

ОБИДЕНЕН ИНСТИТУТ ЗА ЯДРЕНИ ИЗСЛЕДОВАНИЯ

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БІРІККЕН ЯДРОЛЫҚ ЗЕРТТЕУ ИНСТИТУТЫ

연합원자력연구소

INSTITUTO UNIFICADO DE INVESTIGACIONES NUCLEARES

INSTITUTUL UNIFICAT DE CERCETARI NUCLEARE

ЦӨМИЙН ШИНЖИЛГЭЭНИЙ НЭГДСЭН ИНСТИТУТ

ZJEDNOCZONY INSTYTUT BADAŃ JĄDROWYCH

ОБЪЕДИНЕННЫЙ ИНСТИТУТ ЯДЕРНЫХ ИССЛЕДОВАНИЙ

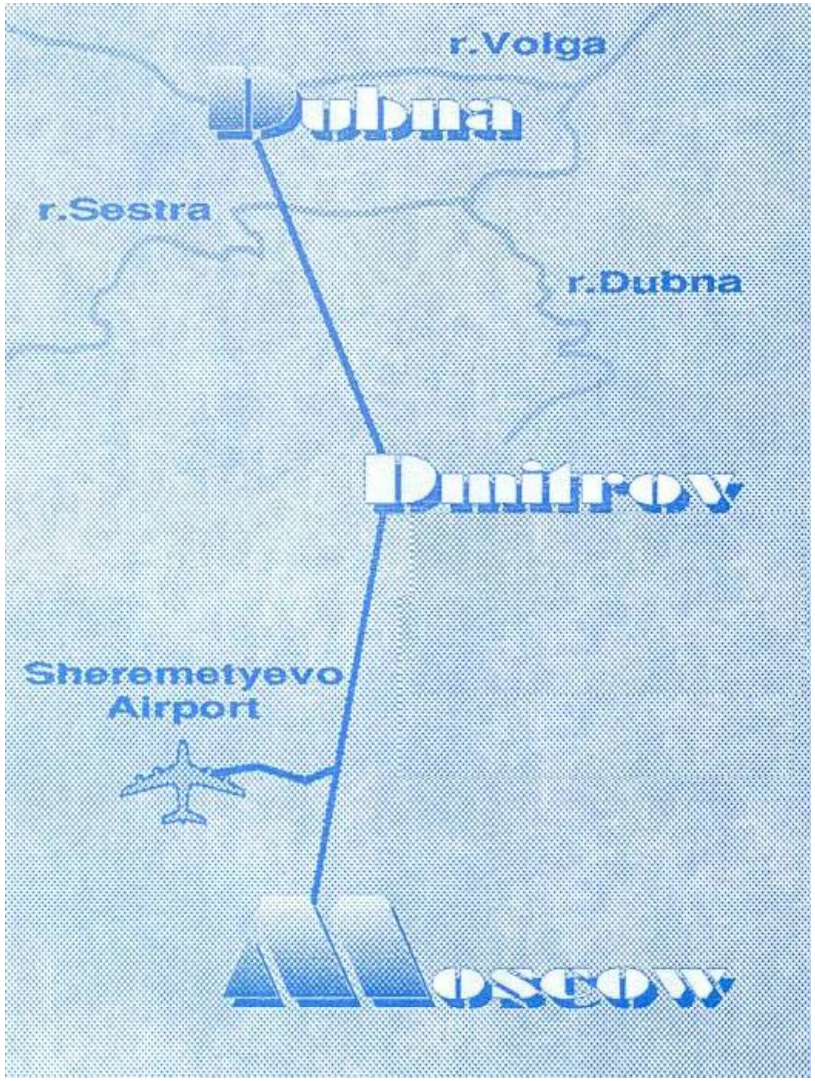
INSTITUTUL UNIFICAT DE CERCETARI NUCLEARE

SPOJENÝ ÚSTAV JADROVÝCH VÝSKUMOV

ЯДРОВИЙ ТАДҚИҚОТЛАР БИРЛАШГАН ИНСТИТУТИ

ОБ'ЄДНАНИЙ ІНСТИТУТ ЯДЕРНИХ ДОСЛИДЖЕНЬ

SPOJENÝ ÚSTAV JADERNÝCH VÝZKUMŮ



Joint Institute for Nuclear Research (JINR) is an international intergovernmental organization located in Dubna, Russian Federation, about 120 km north of Moscow

Photo of Dubna from satellite (look from 250 km height)

JINR Dubna

JINR Member States


Armenia


Azerbaijan


Belarus


Bulgaria


Cuba


Czech Republic


Georgia


Kazakhstan


Democratic People's Republic of Korea


Moldova


Mongolia


Poland


Romania


Russia


Slovak Republic


Ukraine


Uzbekistan


Vietnam

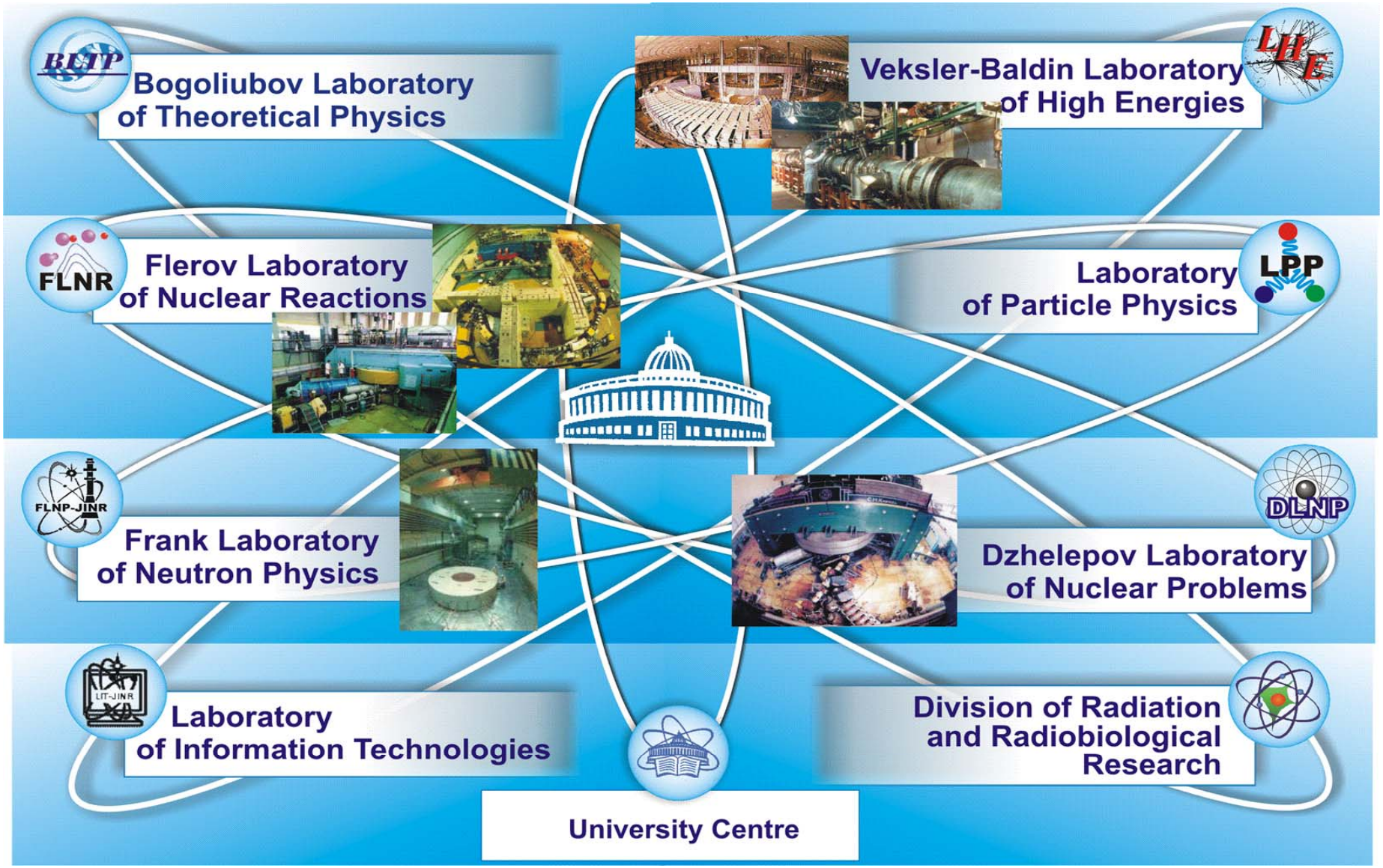
Associated member-states: Germany, Hungary, Italy, South Africa, Serbia.

We expect China and France to joint JINR as associated members in 2008

JINR Dubna

Governing Bodies & Structure

- **Committee of Plenipotentiaries**
  - **Scientific Council**
    - PAC for Particle Physics
    - PAC for Nuclear Physics
    - PAC for Condensed Matter Physics
  - **Directorate**
    - Scientific-Technical Council
    - 8 Laboratories
    - University Centre
    - Office of Administration
  - **Finance Committee**



JINR has grown into a large multi-branch physics centre. It employs about 5500 people, including 1300 scientists. Among the scientists there are full members (academicians) and corresponding members of Academies of Sciences, more than 260 Doctors of Sciences and 650 Candidates of Sciences.

Chronology of JINR in ILC

December 2005 – **GDE in Frascati** – A.N. Sissakian with first proposals from JINR to be involved into global accelerator project and Dubna siting;

January 2006 – a special workgroup on ILC was created at JINR, JINR Scientific Council supports the intention of JINR to participate in the ILC project and the possible interest of JINR to host the ILC

March 2006 – JINR Committee of Plenipotentiaries approved SC recommendation;

May 2006 – **European GDE in DESY** - Detailed information from JINR as from sample site;

July 2006 – **GDE in Vancouver** – Documentation from JINR to BCD with RSPI estimation on CFS (Site Assessment Matrix);

November 2006 – **GDE in Valencia** – Documentation from JINR to RDR with new RSPI estimation on CFS (Work Breakdown Structure) officially submitted.

Dec 2006 – section of the Nuclear Physics of RAS. (Reports: Sissakian, Shirkov)

April 2007 – Moscow region governor supported JINR initiative for ILC site proposal near Dubna. Regional government is ready to support in the frames of its competence

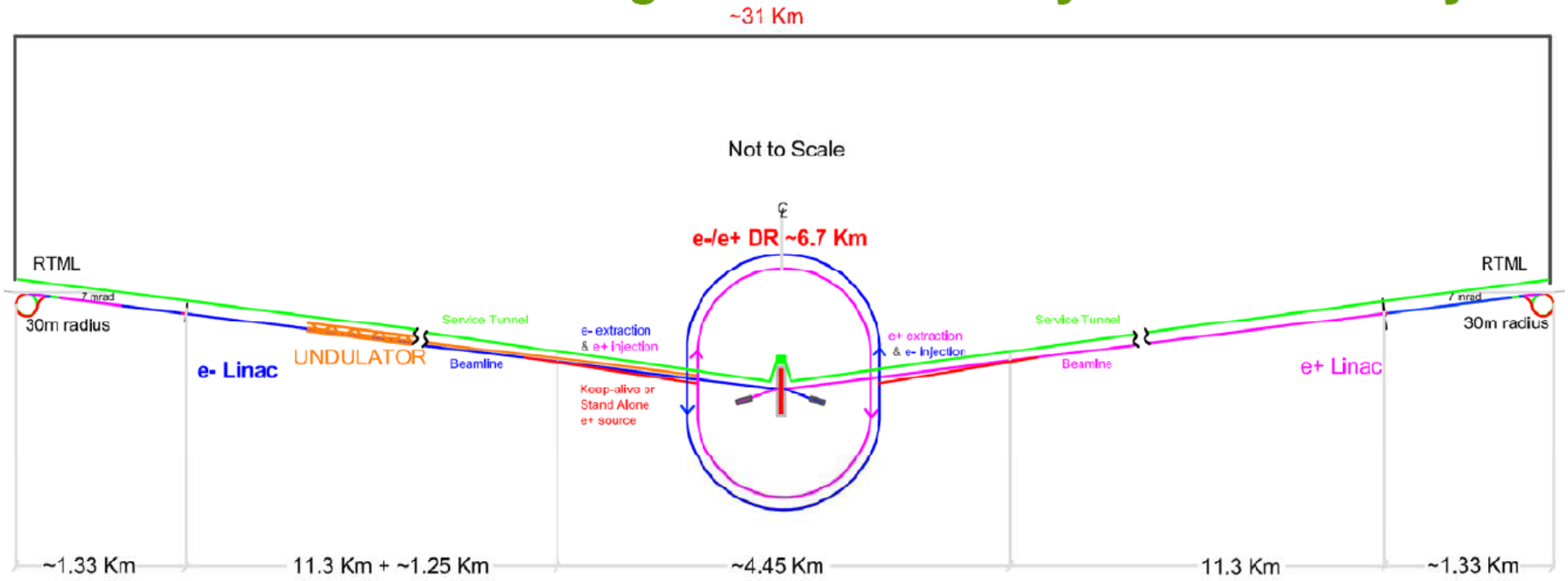
June 2007 – Letter to President V.Putin (signed by Yu.Osipov (RAS), B.Gromov (MG), A.Sissakian (JINR) with appeal to support the JINR initiative

Sept 2007 – **Crimea** – international workshop on electron/positron colliders (linear and circular) – in collaboration with BINP (Novosibirsk);

October 2007 - GDE decision to hold the next **European GDE meeting at Dubna** in June 2008.

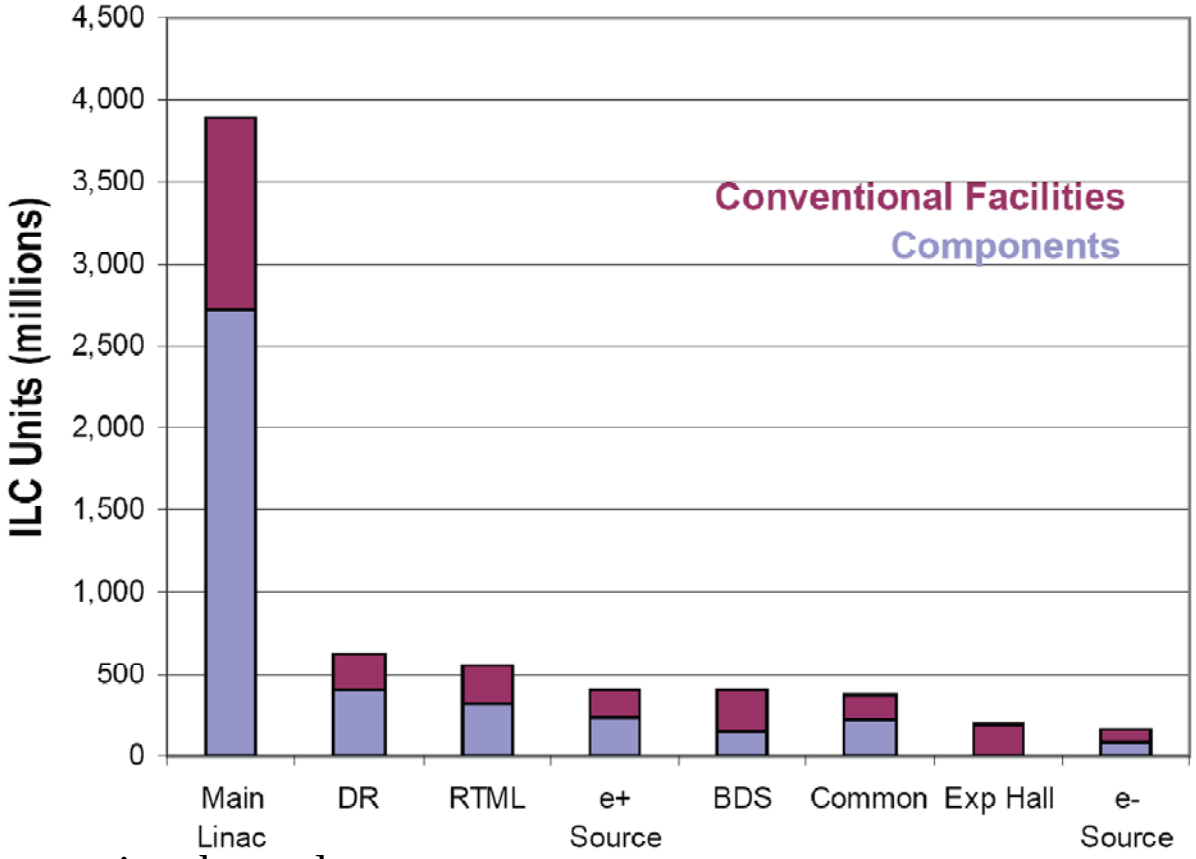
New scheme of the ILC (according to RDR)

- 11km SC linacs operating at 31.5 MV/m for 500 GeV
- Centralized injector
  - Circular damping rings for electrons and positrons
  - Undulator-based positron source
- Single IR with 14 mrad crossing angle
- Dual tunnel configuration for safety and availability



Value Estimate

The value and explicit labor estimates are current as of 01.02.2007



The estimate contains three elements:

- 1.83 Billion (ILC Units) for site-dependent costs, such as the costs for tunneling in a specific region
- 4.79 Billion (ILC Units) for shared value of the high technology and conventional components
- 14,200 person-years for the required supporting manpower (=24 million person-hours)

For this value estimate: 1 ILC Unit = 1 US 2007$ (= 0.83 Euro = 117 Yen)

…from RDR, Sample Sites section...

For this reference design, three 'sample sites for the ILC were evaluated. Each site was required to be able to accommodate all the conventional facilities for the 500 GeV CM machine; in addition, the sites needed to have the sufficient length to support an upgrade of the machine to 1 TeV CM, assuming the baseline main linac gradient. There were two reasons for the use of three sample sites for this reference design:

- This procedure demonstrates that each region can provide at least one satisfactory site for the ILC. This is important, since it shows that any of the regions has the potential to be a host for the project.
- The cost of, and technical constraints on, the project could depend strongly on the site characteristics. Since the actual site is not yet known, it is important to assess a range of sites with a diverse set of site characteristics, to provide confidence that when the actual site is chosen, it will not present unexpected technical difficulties or major surprises in cost.

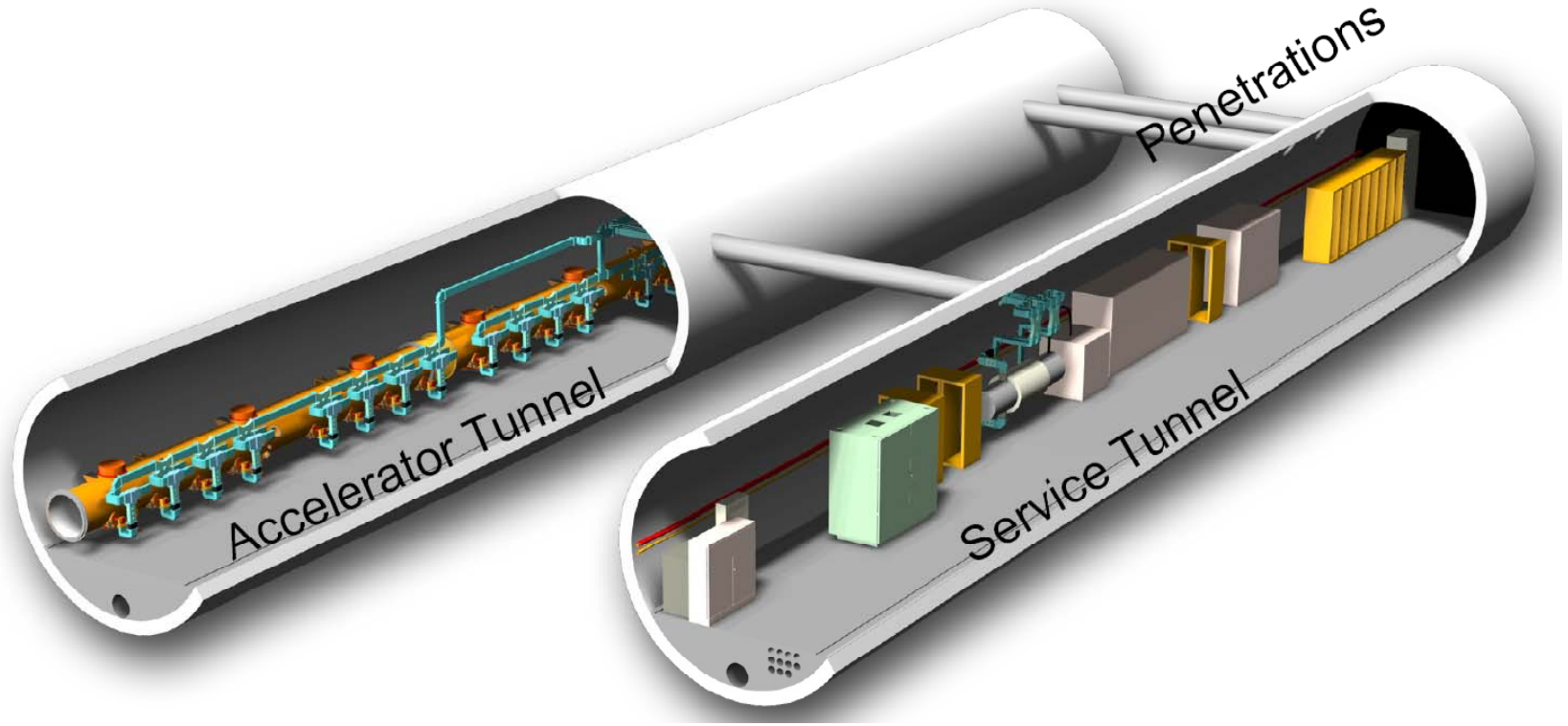
In addition to the three sample sites presented, a second European sample site near DESY in Hamburg, Germany, has also been developed. This site is significantly different from the other sites, both in geology and depth (~25 m deep), and requires further study.

The Joint Institute for Nuclear Research has also submitted a proposal to site the ILC in the neighborhood of Dubna, Russian Federation.

The three sites reported in detail here are all deep-tunnel solutions. The DESY and Dubna sites are both examples of shallow sites. A more complete study of a shallow site – either a shallow tunnel or a cut-and-cover site – will be made in the future as part of the Engineering and Design phase.

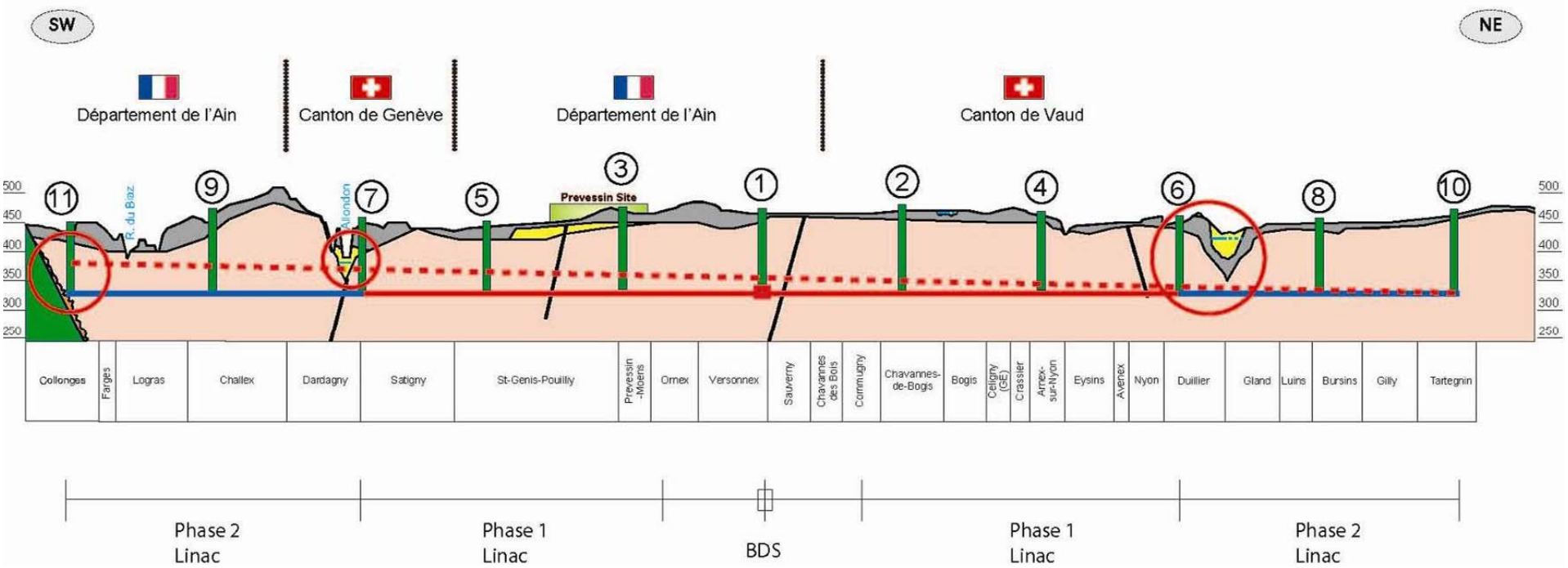
ILC tunnel layout

Deep (~100 m), diameter 4-5 m, separated with ~ 5 m.

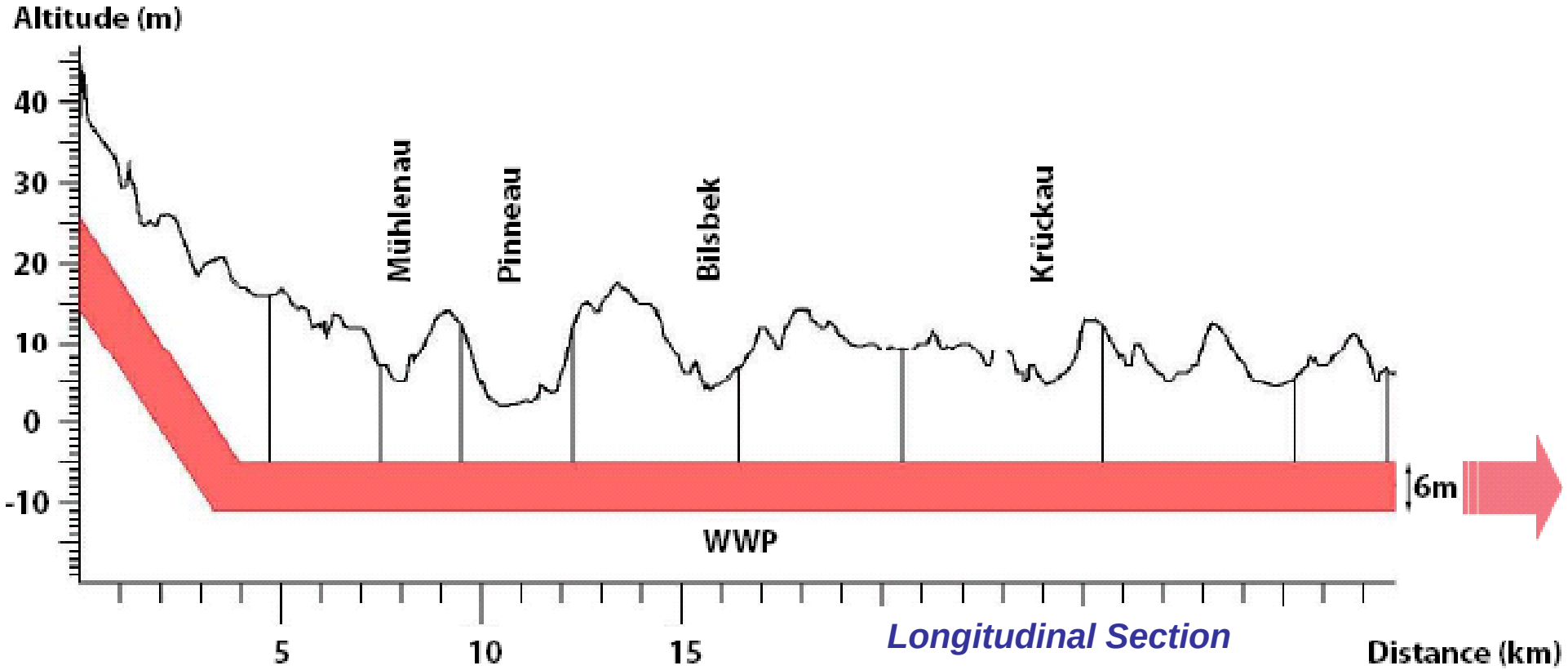


EUROPEAN SAMPLE SITE - CERN

Longitudinal Section

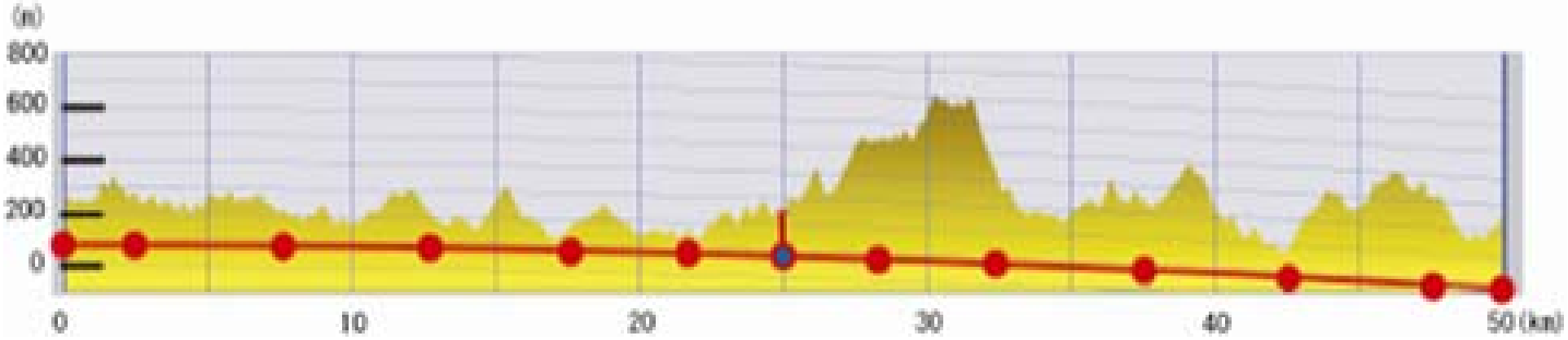


EUROPEAN SAMPLE SITE - DESY



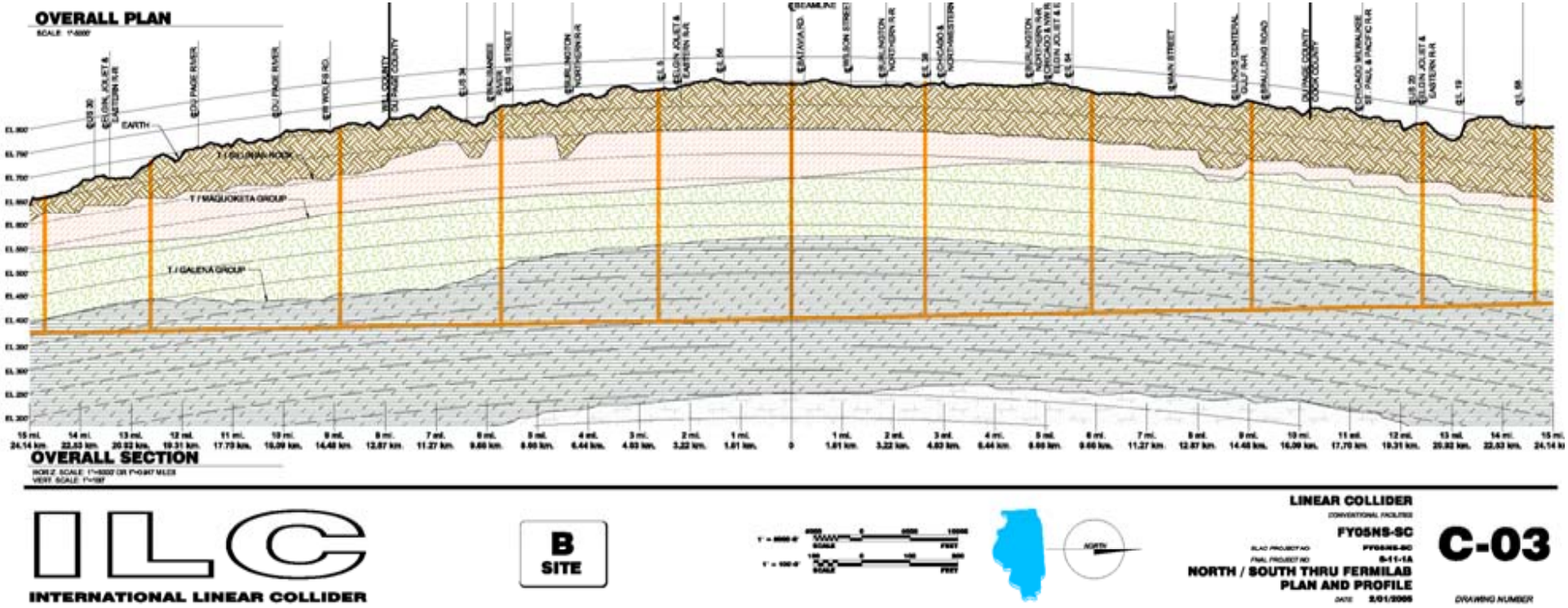
Longitudinal Section

ASIAN SAMPLE SITE



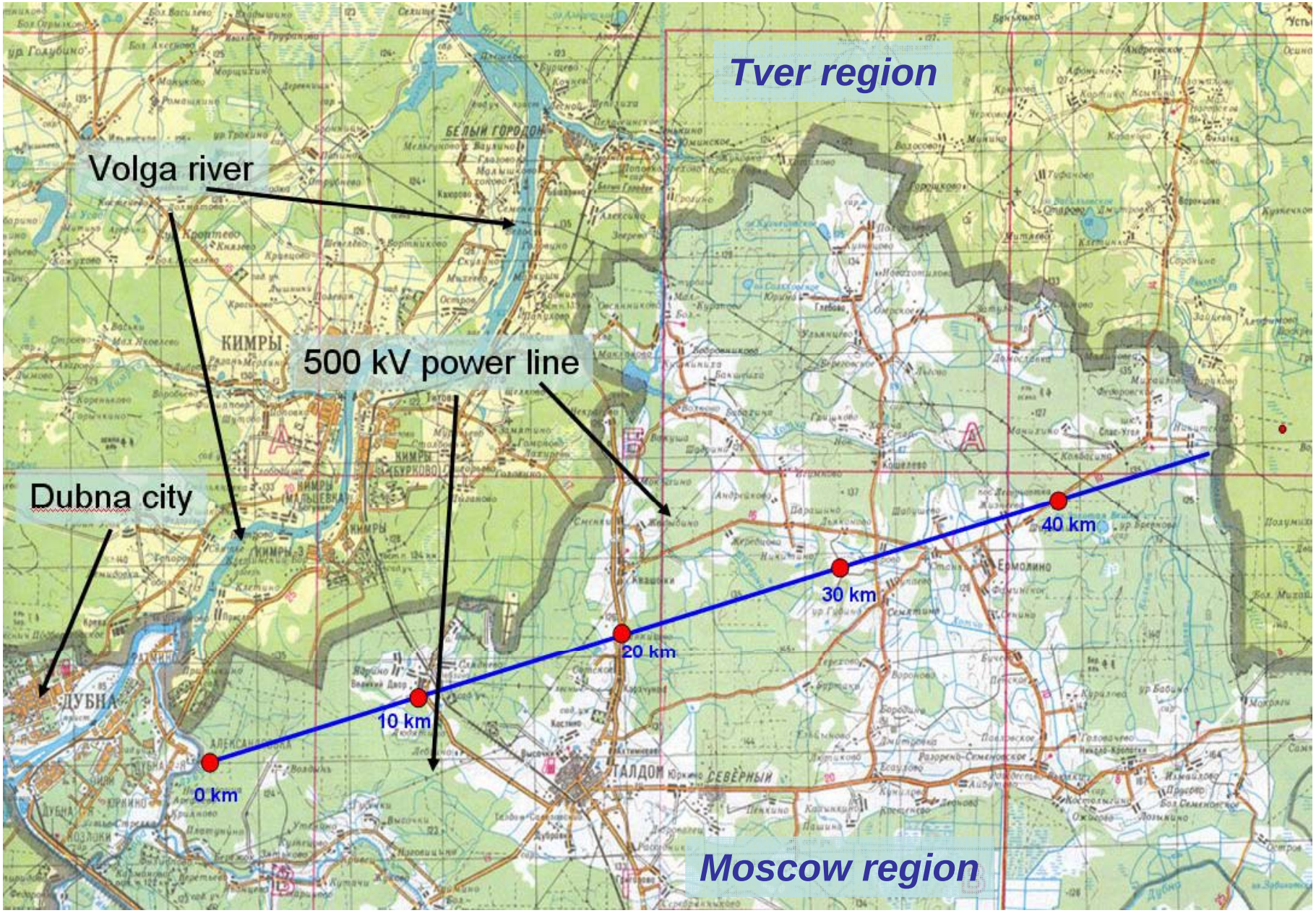
Longitudinal Section

AMERICAS SAMPLE SITE



Longitudinal Section

Dubna Siting: Layout of ILC in the Moscow Region



Advantages of the ILC construction in Dubna:

1. The presence of JINR as a basic scientific and organizational structure. JINR is an international intergovernmental organization, which includes 18 Member States and 5 States, which are associated members.

2. The proposed territory is extremely thinly populated and practically free of industrial structures, rivers and roads. The proposed placement of the accelerator tunnels in relatively dry drift clay excludes the influence on abyssal distribution of the underwater.

3. The area is absolutely steady seismically and has stable geological characteristics.

4. A flat relief and the unique geological conditions allow one to place ILC on a small depth (about 20 m) and to perform construction of tunnels, experimental halls and other underground objects with the least expenses, including open working.

5. The extremely attractive feature of placing the ILC complex on the chosen territory is a unique opportunity to solve the problem of value at the purchase of land. Prevalent legal practice makes it possible to get the land of the ILC location to permanent free use just as it has been done for JINR, according to the agreement between JINR and the RF government.

6. There are sources of the electric power of sufficient capacity in the area of the ILC construction: transmission line of 500 kV, the Konakovo electric power station (EPS) and the Udomlia atomic power plant (APP).

7. The developed system of transport and communication services, advantageous location, good highways and railways, water-way (the Volga river basin), good position in the European region;

8. Presence of a modern network and information infrastructure, including one of the largest center in Europe the “Dubna” Satellite Communication Center.

9. A special the economic zone established in Dubna in December, 2005 provides preferential terms for development and manufacture of high technology technical production.

10. Dubna has a powerful scientific and technical potential. The developed infrastructure makes it possible to involve additionally specialists from world scientific centers into the already formed international collective of highly-qualified scientific manpower providing comfortable conditions for them to work. This guarantees a high quality of investigations on ILC and obtaining of new research results of fundamental scientific importance.

Russian Satellite Communication Center
Possible starting point of ILC layout, between Dubna and Volga rivers

Area and Climate

The area is thinly populated, the path of the accelerator traverses 2 small settlements and a railway with light traffic between Taldom and Kimry. Possible “line” crosses only the railway to Savelovo (of low utilization) and the River Hotcha with a very small flow rate.

There are no any national parks, biological reservations, any religious and historical places an the planned area. There are no new projects planned to develop on the allocated territory.

It possible to avoid purchasing land and get the development area for free use without time-limit; like that has been done for the JINR as for international intergovernmental organization by the existing agreement between the JINR and the Government of the Russian Federation.

The climate is temperate-continental. The mean temperature in January is –10.7°C. The mean temperature in July is +17.8°C. The mean annual rainfall is 783 mm. The mean wind speed is 3.2 m/s. Strong winds (15 m/s) blow only 8 days/year. According to the climatic parameters, the territory of Dubna is considered to be comfortable.

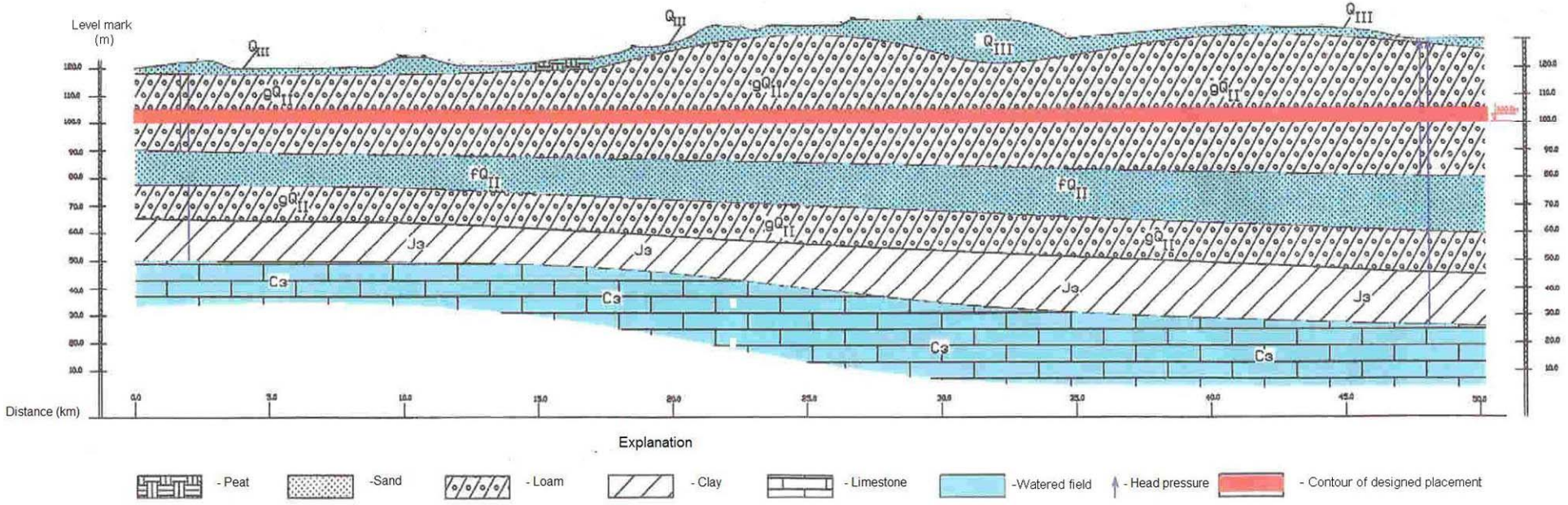
Relief

The area of the proposed location of the accelerator is situated within the Upper Volga lowland. The characteristic feature of this territory is the uniformity, monolithic character of the surface. The existing rises of the relief in the form of single hills and ridges have smoothed shapes, soft outlines and small excesses. The territory of the area is waterlogged. The absolute marks of the surface range from 125 to 135 m with regard to the level of the Baltic Sea.

The difference of surface marks is in the range of 10 m only on the base of 50 km.

The ILC linear accelerator is proposed to be placed in the drift clay at the depth of 20 m (at the mark of 100.00 m) with the idea that below the tunnel there should be impermeable soil preventing from the underlying groundwater inrush. It is possible to construct tunnels of the accelerating complex using tunnel shields with a simultaneous wall timbering by tubing or falsework concreting.

Standard tunnel shields in the drift clay provide for daily speed of the drilling progress specified by the Project of the accelerator (it is needed approximately 2.5 years for the 50 km tunnel).



Geology

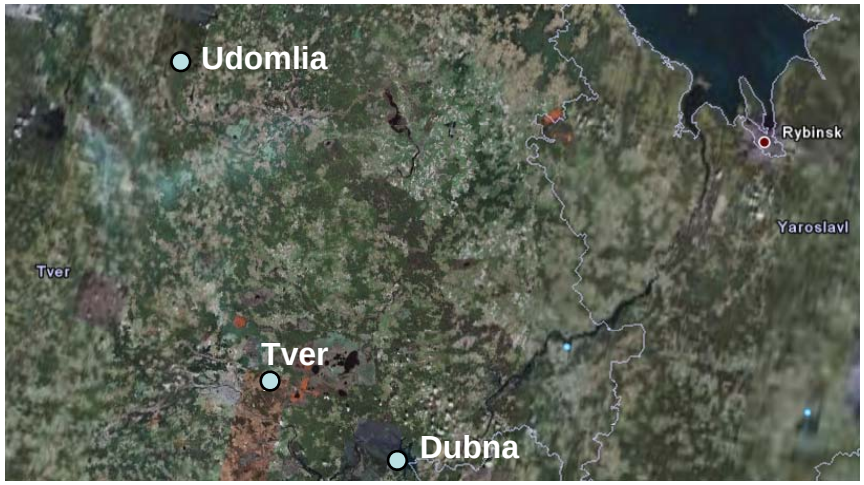
The area of the proposed location of the accelerator is situated within the Russian plate – a part of the Eastern European ancient platform – a stable, steady structural element of the earth's crust.

The Russian plate, like all the other plates, has a well-defined double-tier structure. The lower tier or structural floor is formed by the ancient – lower Proterozoic and Archaean strata of metamorphic and abyssal rocks, which are more than 1.7 billion of years old. All these strata are welded into a single tough body – the foundation of the platform. The area of the ILC accelerator is located in the southern part of a very gently sloping saucer-shaped structure – the Moscovian syneclise.

Alluvial deposits i.e. fine water-saturated sands, 1-5 m of thickness. Below one can find semisolid drift clay of the Moscovian glaciation with exception of detritus and igneous rocks. The thickness of moraine deposits is 30-40 m.

Power and energetic

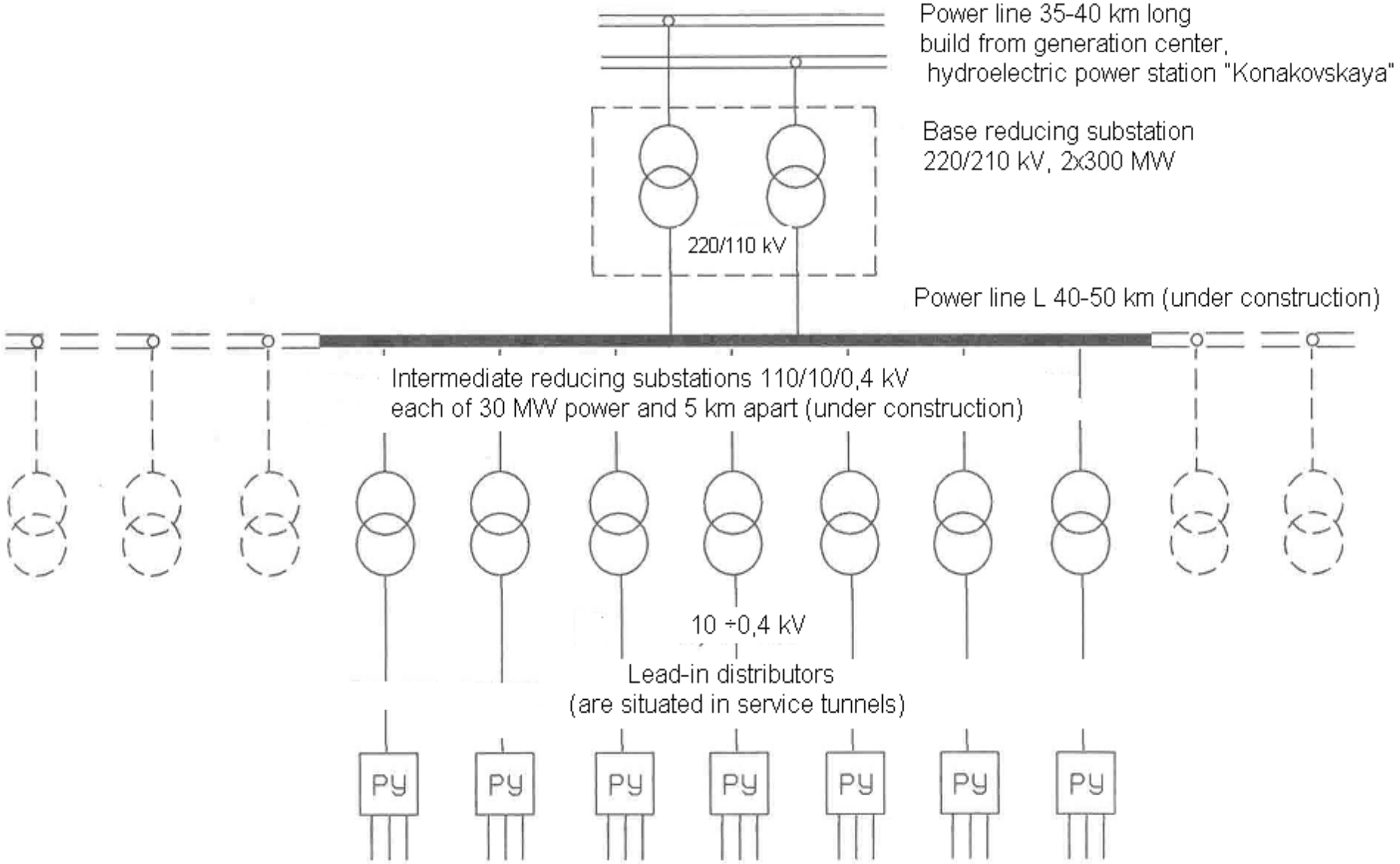
The northern part of Moscow region and the neighboring regions have a developed system of objects of generation and transmission of electrical energy. There are first-rate generating stations: the Konakovo EPS (electric power station, ~30 km from Dubna) and the Udomlia APP (atomic power plant, ~170 km from Dubna). Two trunk transmission lines with the voltage 220 kV and 500 kV pass through the territory of Dubna.



The investigation of possibilities of the power supply for the accelerator and its infrastructure with the total power up to 300 MW gives the following variant:
Construction of the power line - 220 kV, 35÷40 km long, directly from the center of generation – the Konakovo EPS to the Central Experimental Zone of the accelerator with a head step-down substations 220/110 kV.

It will require the investment in larger amount but the cost of power obtained directly from the centers of generation will be lower for 40÷50 %.

Power Supply Scheme



Documentation and Cost Estimation

July 2006 (for Vancouver GDE): JINR prepared and filled the necessary documents for possible ILC hosting to BCD (CFS chapter) – the *Site Assessment Matrix*.

Official document from Russian State Project Institute (GSPI, Moscow) with estimations on:

- Conventional facilities cost
- Siting (tunnel, land acquisition) cost and time schedule
- Energetic and power cost
- Operational cost
- Labor cost

November 2006 (for Valencia GDE):
JINR prepared and filled the necessary documents as a sample site for possible ILC hosting to RDR *(Work Breakdown Structure - WBS)*.
This document was also prepared with GSPI and submitted by Design Cost Board of GDE.

Russian State Project Institute (GSPI, Moscow) – the most powerful and professional institute in Russia with 60 years history: design and construction of almost all Soviet and Russian Nuclear power stations, Nuclear centers (Sarov, etc), Scientific Nuclear accelerator centers (JINR Dubna, IHEP Protvino, ITEP Moscow, INR Troitsk, etc)

МИНИСТЕРСТВО ПРОМЫШЛЕННОСТИ И НАУКИ МОСКОВСКОЙ ОБЛАСТИ

125009, Москва, ул. Тверская, 12, стр. 2 тел.: 629-61-62, факс: 629-02-52

29.03.2007 № 15.3-589/1

На № _____ от _____

Директору Объединенного
института ядерных исследований

А.Н. Сисакяну

Уважаемый Алексей Норайрович!

Министерству промышленности и науки Московской области поручено проинформировать Вас, что Губернатор Московской области Б.В. Громов поддерживает инициативу ОИЯИ по размещению Международного Линейного Коллайдера на территории Московской области и готов на соответствующем этапе оказать содействие в пределах полномочий Московской области как субъекта Российской Федерации (обращение от 16.02.2007 № 010-28/186).

С уважением,

Министр В.И. Козырев

√ Тюрнову ГО
Для работы.

Объединенный институт ядерных исследований
Входящий № 219
30 03 2007
Копы листов 1

Шиец В.И., 692-26-87

Letter to President of Russian Federation Vladimir Putin

Signed by:

Moscow region Governor	**Boris Gromov**
President of RAS	**Yury Osipov**
Director of JINR	**Alexey Sissakian**

June 2007

Plans for 2008 (provided with Moscow region government)

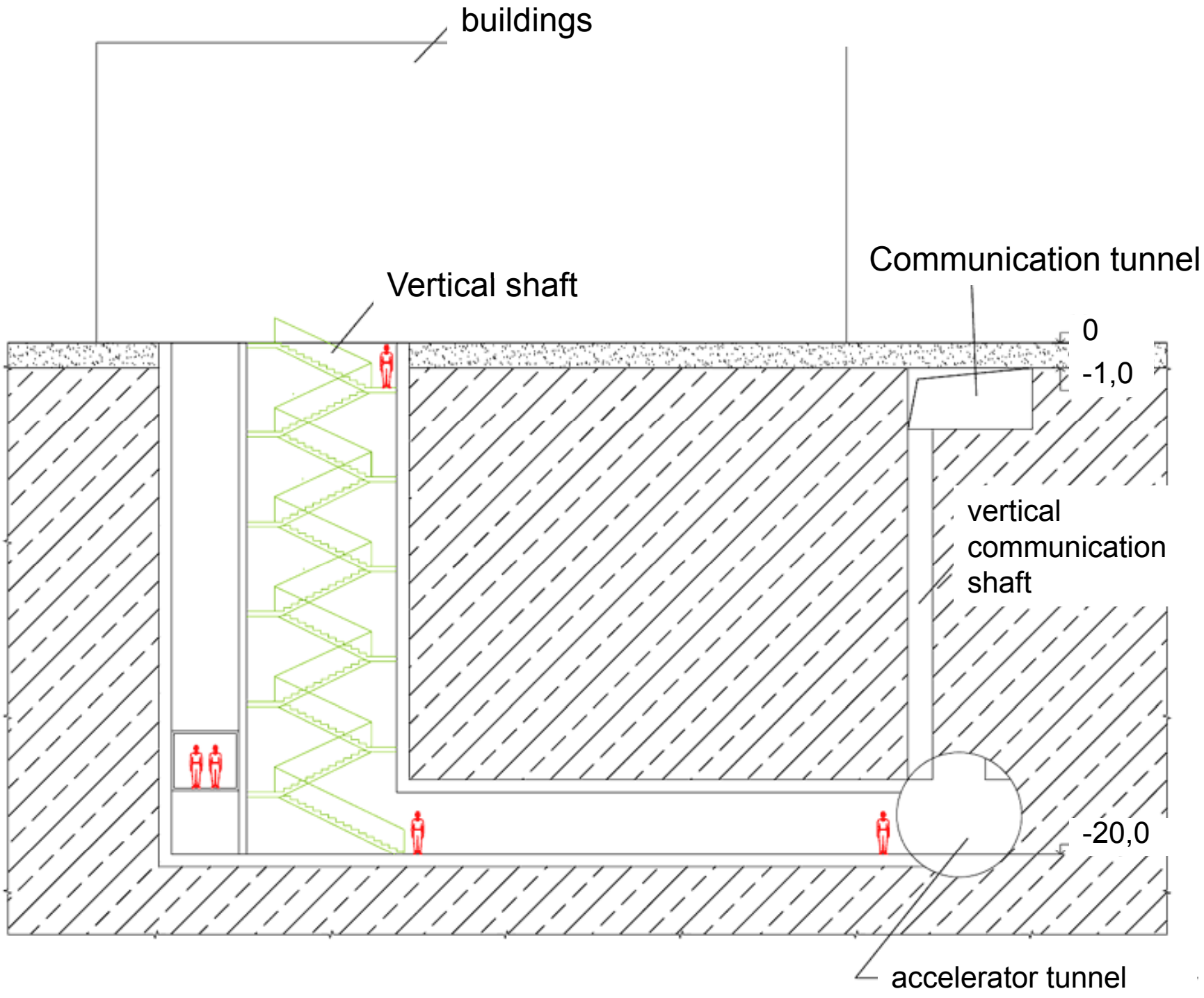
- **Basic data acquisition for construction R&D works of ILC project.**

- **To provide routing researches with the description of characteristics of the offered line of the accelerator location and the infrastructure connected with it;**

- **To specify character of surface structures, real population, topographical features (including depth of the crossed rivers and other reservoirs), an actual accessory and economic use of the wood and ground resources getting in a zone of alienation of the accelerator;**

- **To check a real state of a road network in area of prospective construction, an opportunity of its use at a stage of a pre-construction works and during a construction and operation of an accelerating complex;**

- **To provide drilling of several control prospecting chinks for acknowledgement of prospective soil structure on the chosen line of the accelerator location.**


buildings
Vertical shaft
Communication tunnel
0
-1,0
vertical
communication
shaft
-20,0
accelerator tunnel

A new suggested variant of the accelerator tunnel layout is under discussion and estimations now. It assumes the following:

• main (beam) tunnel is located at approximately -20 m (at abs. level -100 m) in order to have impermeable layer above and below to be prevented from subsoil waters;

• service (communication) tunnel is located directly above the main and around the earth surface (<-3-4 m), practically repeating the relief;

• technological connection between two tunnels is provided with vertical shafts of different diameters, which are drilled with usual method;

• connection between surface buildings and underground infrastructure is provided with vertical and horizontal shafts (elevators, stairs, etc).

Such a variant is more efficient economical by several reasons:

• Service (communication) tunnel can have any size (section) for loading or filling the beam tunnel with any equipment, it is made by open-cut method;

• Vertical connections are made by well-boring (relatively cheap method in comparison with case of horizontal ones), at the same time their number and sizes can be optimized. In addition – they do not require damp course;

• Export of the drain waters is provided directly in accordance with relief, without any pumping stations;

• Exploitation of the communication tunnels is sufficiently easier;

• Cable and other technological connections between service tunnel with surface building is sufficiently reduced.

GDE Meeting

ILC Conventional Facilities and Siting Workshop

June 3 - 7, 2008

JINR, Dubna, RUSSIA

Program Committee

Barry Barish
Mike Harrison
Brian Foster
Mitsuaki Nozaki
Ewan Paterson
Marc Ross
Grigory Shirkov
Alexey Sissakian
Nicolas Walker
Akira Yamamoto
Kaoru Yokoya

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(visa application, transportation and accomodation)
e-mail pollyakova@jinr.ru

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Local Organizing Committee:

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Shirkov G. - co chairman
Trubnikov G. - scientific secretary
Kekelidze V. - coordinator
Kuznetsova E. - secretary
Budagov Ju.
Meshkov I.
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Welcome to JINR Dubna

JINR Dubna