CALL

for market consultation No.47689 with the following subject matter: ”Modernisation of fuel handling machines 5,6PL00E01, type МПС-В-1000-3М-У 4.2”

Kozloduy NPP EAD informs all interested parties that in connection with the the preparation for the award of a public procurement and determination of the estimated value pursuant to Article 44 of the PPA is collecting indicative proposals for ”Modernisation of fuel handling machines 5,6PL00E01, type МПС-В-1000-3М-У 4.2”

The proposals should include:

- total service performance price and the price for each stage of the technical requirements for service performance – for development and approval of the detailed design, supply of required equipment, implementation of the detailed design and commissioning of the equipment;
- information about service deadline;
- exact address and contact person, telephone number, fax number, e-mail, and web site.

Inquiries regarding the market consultations may be made by 15.10.2021 at the following e-mail address: commercial@npp.bg, as the clarifications will be published in the Buyer profile – Market Consultations Section.

Deadline for the receipt of the indicative proposals: 21.10.2021 at the following e-mail address: commercial@npp.bg.

The indicative proposals and any other information exchanged during the market consultations held shall be published in the Buyer profile, Market Consultations Section.

By submitting an indicative proposal, each participant in the market consultations agrees that the proposal and any other information provided as a result of the market consultations shall be made available to the public in the Buyer profile.

The Contracting Authority retains the rights to use indicative proposals received in the course of market consultations for awarding public procurements up to the value thresholds of Art. 20, para. 4 of the PPA.

Any further information may be obtained from Violetka Dimitrova, Head of Contracts Department, Commercial Division, telephone: +359 973 7 3977.

Enclosures:

1. Technical requirements for market consultation Item: ”Modernisation of fuel handling machines 5,6PL00E01, type МПС-В-1000-3М-У 4.2”

Kozloduy NPP EAD

TECHNICAL REQUIREMENTS

for market consultation

SUBJECT:

Modernisation of fuel handling machines 5,6PL00E01, type МПС–В–1000–3М–У 4.2

1. Summary of the Terms of Reference

Subject of the Terms of Reference is the modernisation of fuel handling machines (FHM) 5,6PL00E01, type МПС–В–1000–3М–У 4.2 which are in operation at Kozloduy NPP.

Fuel handling machines type МПС–В–1000–3М–У 4.2 were manufactured in 1985 for Unit 5 and 1988 for Unit 6 by Ganz Mavag and were designed for nuclear fuel handling.

The activities under this ToR include the design, procurement, installation, and commissioning of FHMs type МПС–В–1000–3М–У 4.2 in the scope as per Investigation Report No. GEB/1503/20 of 29.10.2020 prepared by Ganz EEG Kft (successor of Ganz Mavag).

For the mechanical part:

• Procurement of an upgraded gripper assembly for reliable engagement/disengagement as well as to prevent hang-ups;

• Procurement of an entire bridge drive equipped with brakes before and after the reduction drive;

• Procurement of an entire carriage drive equipped with brakes before and after the reduction drive;

• Replacement of the mast and its drive mechanism;

• Replacement of the turntable rotation drive;

• Procurement of modified seismic supporting structures with a permanent magnet and inductive sensor;

• Replacement or preservation of existing air supply and sampling lines of the fuel rod cladding integrity surveillance systems - 5, 6PP70. Preserve the air supply nozzles unit. The connection points of the air supply and sampling lines to the process part of systems 5, 6PP70 shall be installed on the FHM carriage;

• Procurement of a cable conductor to provide for greater rotation angle;

• Procurement of a fixed mast kit (with spare parts and tools - SPT);

• Procurement of a telescopic mast kit (SPT);

• Reconsideration of the SPT kit, procurement of a new kit.

For the electrical part:

• Replacement of the FHM electrical part, including the control system, in relation to design life expiry, as per the FHM CS technical specification No. 6-115-0058 of 2000;

• Replacement of drive motors, including the ones not specified in the mechanical part, in order to use one and the same manufacturer for all the mechanisms; unification if possible of all the motors and application of a unified (same) motor control method (use of motor control units of the same manufacturer);

• Based on the safety analysis results concerning the refuelling process, additional sensors shall be installed (if necessary) on the FHM;

• Replacement of sensors with newer ones – instead of the aged FHM sensors and in order to use a unified component inventory for all mechanisms, standard interfaces compatible with the contemporary controllers (as part of the FHM CS). The types of sensors shall be agreed in the initial stage of the Modernisation Project;

• Replacement of the FHM CS with a newer one using contemporary and upgraded (designed not earlier than 10 years ago), standardized components purchased by leading manufacturers of electronics (controllers, transducers, etc.) and electrical components. The FHM CS shall meet the contemporary high standards in the regulations governing the use of nuclear energy and correct the shortcomings of the existing FHM CS;

• The FHM CS power supply shall be provided by two three-phase AC (~380 V, 50 Hz) cable lines of the independent 0.4kV house load switchgears. The loads supplied by those lines must not exceed 25kWA. Type of network earthing – TN-S (conductors L1, L2, L3, N, PE);

• A video connection shall be established between the FHM control panel and rooms 5, 6A1015, by means of installing visual display units to visualise the data from the camera display;

• Keep the existing power supply of system 5, 6PP70 from 5, 6CP2, cell 11 (bottom), including in the electrical cabinet at elevation 36.90;

• The FHM shall be completed with a video system based on IP cameras to ensure visualisation of the FHM servicing area. The cameras shall be installed on the FHM upper platform consoles. The receiving part shall be integrated in the control panel of the FHM CS (display, receiving equipment);

• Replace the existing video system СТС-ПМ-100 with a newer one.

Prior to implementation of the activities, a safety analysis shall be performed of the refuelling process and additional requirements and recommendations shall be defined in order to

ensure the refuelling process safety thus harmonising the modernised FHM with the current (updated) safety regulations (Russian and international). The scope of safety regulations shall be defined as part of the implementation of the Modernisation Project;

2. Design requirements

Taking into account the extended to 60 years life of Units 5 and 6, modernisation of the FHMs is required in order to ensure their operability in line with the current technologies and compliance of those technologies with the safety and reliability requirements until shutdown of the units.

The main Modernisation Project functions are to replace the electrical equipment whose design life has expired, including FHM CS, motors and sensors, thus enabling the replacement of obsolete and physically aged FHM components and ensuring its maintainability and compliance with the current reliability requirements.

It is required for the Project to cover contemporary design solutions which will provide for improvement of the FHM operating characteristics to meet the performance of the state-of-the-art FHMs installed on the new WWER-1200.

The scope of applicable regulations will be defined in the initial stage of the FHM Modernisation Project.

Safety class of the fuel handling machine – **2-Н**, as per НП-001-15 “Общие положения обеспечения безопасности атомных станций” (General provisions for the safety of nuclear power plants);

The fuel handling machines are categorized as **Seismic Category 1 (one)** as per НП-031-01 “Нормы проектирование сеисмостойких атомных станций” (Standards for design of seismically resistant nuclear power plants).

The activities under this ToR shall be completed in 3 stages:

- **Stage 1** – Drafting and approval of a Detailed Design;
- **Stage 2** – Procurement of the required equipment;
- **Stage 3** – Implementation of the Detailed Design and commissioning of the equipment.

The Procurement and Implementation stages shall commence upon approval of the Detailed Design in Stage 1.

Stage 1 implementation period – 5 months from the date of submission of input data.

Stage 2 period for procurement of the equipment – 7 months from the date of approval of the Project (Stage 1) at a session of the Expert Technical Council.

Stage 3 implementation period – 1 month as per the relevant unit outage schedule.

Prior to commencement of Stage 1, it is obligatory to provide the Contractor with access to the visual inspection systems and collection of the required input data.

Final period for implementation of the activities under this ToR – 13 months per unit.

The separate parts of the Detailed Design shall contain the relevant sections and shall be prepared as per the requirements specified in this ToR.

The Detailed Design shall cover the specific design modifications to an extent ensuring complete implementation of any installation works. The Detailed Design shall be accepted and approved at a Technical Council of the Contracting Authority.

The Detailed Design shall be prepared separately for Units 5 and 6.

2.1. Description of the requirements applying to the individual parts of the Design

The separate parts of the Detailed Design shall be prepared:

- As per the scope and content stipulated in Regulation No. 4 of 21.05.2001 on the investment projects' scope and content;

- Design drafting shall comply with the Regulation on Ensuring the Safety of Nuclear Power Plants;

- Conforming to the national legislation.

The Detailed Design shall cover:

- Calculations verifying the Design compliance with the engineering requirements and ToR;

- A design modification with clearly defined battery limits and description of design functions;

- Detail (assembly) drawings facilitating the design modification;

- Technical specification of the components subject to replacement and modernisation;

- Installation and commissioning evaluation.

General engineering requirements to the Design:

- Ensure operability of the newly integrated systems in the containment at ambient temperature in the range: +10 ÷ +60°C;

2.2. The Design parts concerning technology are as follows:

2.2.1 Architectural Part

Not applicable.

2.2.2 Structural Part

Current situation:

This part shall consist of:

- Specific design modifications to an extent ensuring complete implementation of any installation works;

- Drawings depicting the location and method of installation of the new equipment as well as details on its execution;

- The structural elements required to fix the new equipment in place;

- Material specification and quantitative calculation for the installation of the new equipment;

- The scope of disassembly and assembly works to be performed as part of the Project.

The recommendations and requirements for the seismic qualification of equipment, piping and supporting structures are presented in Attachment 1 to the ToR, Specification of the Seismic Requirements for Equipment, No. Сп.ХТС 22/09.06.2021.

In case the loading of the relevant civil structure does not change, a Structural Statement (Act 14) shall be attached to this part. It shall be prepared as per the scope stipulated in i. 2.4 and Chapter 9, Section I, II and III of Regulation No. 4 on the investment projects' scope and content.

2.2.3 Electrical Part

The modernisation of the FHM electrical part shall cover:

• Replacement of the FHM electrical part, including the control system, in relation to design life expiry, as per the FHM CS technical specification No. 6-115-0058 of 2000;

• Replacement of drive motors, including the ones not specified in the mechanical part, in order to use one and the same manufacturer for all the mechanisms; unification if possible of all the electric motors and application of a unified (same) motor control method (use of motor control units of the same manufacturer);

• Use electric motors Sew Eurodrive (electric motors of series DRS, gearmotor of series KA.(37/57/107 etc.) or analogues (three-phase induction motors). Generally, the three-phase induction motor consists of: Disc brake, stator coil temperature sensor, incremental encoder (ensuring drive control, positioning as per the sensor);

• Safety analyses of the refuelling process based on which a justification and installation of additional sensors on the FHM shall be carried out (if necessary);

• Replacement of sensors with newer ones – instead of the aged FHM sensors and in order to use a unified component inventory for all mechanisms, standard interfaces compatible with the contemporary controllers (as part of the FHM CS). Limit switches Honeywell or Siemens of series 3SE5 or analogues shall be used for the modernisation; multicircuit limit switches Stromag of series 100 XX NE... (analogous to the ones already installed on the FHM) or analogues. In respect of position sensors, absolute encoders manufactured by TR-Electronic of series CEH58M or CEV58M whose interface is compatible with the Siemens controllers or analogues shall be used. The types of sensors shall be agreed in the initial stage of the Modernisation Project;

• Replacement of the FHM CS with a newer one using contemporary and upgraded (designed not earlier than 10 years ago), standardized components purchased by leading manufacturers of electronics (controllers, transducers, etc.) and electrical components. The FHM CS shall meet the contemporary high standards in the regulations governing the use of nuclear energy and correct the shortcomings of the existing FHM CS;

• Installation of a FHM with a video system based on IP cameras to ensure visualisation of the FHM servicing area. The cameras shall be installed on the FHM upper platform consoles. The

receiving part shall be integrated in the Control Panel of the FHM CS (display, receiving equipment);

• Keep and use the existing power supply of system 5, 6PP70 from 5, 6CP2, cell 11 (bottom), including in the electrical cabinet at elevation 36.90; The FHM CS power supply shall be provided by two three-phase AC (~380V, 50 Hz) cable lines of the independent 0.4kV house load switchgears. The loads supplied by those lines must not exceed 25kWA. Type of network earthing – TN-S (conductors L1, L2, L3, N, PE);

• Replace the existing video system СТС-ПМ-100 with a newer one;

• The laying of new cables, taking into account the ambient conditions. The selected cables shall withstand the ambient conditions. The newly laid cables must prevent the spread of fire;

• The cables shall comply with IEEE Std 383/1974- IEEE Standard for Type Test of Class IE Electric Cables, Field Splices and Connections in Nuclear Power Generating Stations;

• The cables that are to be used in the Design shall have residual life of at least 30 years and insulation voltage no less than 500V;

• Replacement of cable trays if necessary. The new cable trays (along with structural elements, supports, etc.), if present, shall be capable of withstanding the ambient conditions at the locations they are to be installed;

• The components to be designed shall be labelled in compliance with the following procedures in place at the Kozloduy NPP Units 5 and 6: 30.ОУ.00.АД.29 and 30.ОУ.ОК.ИК.15;

• In the beginning of the designing process, the Contractor shall inspect and measure the FHM in the field and coordinate its actions with a representative of the Contracting Authority.

This part of the Design must consider the fire hazard and category of the premises stipulated in Regulation No. Із-1971 of 29.10.2009 on the construction and engineering codes and standards ensuring safety in the event of a fire.

The following documents shall be prepared as part of the designing process:

- Detailed Cable Log – power, control and monitoring cables;
- Detailed Control Algorithm;
- Designer’s Instructions for adjustment of the equipment procured;
- FHM Performance Test Programme in relation to the new FHM CS;
- Operating Procedure(s) as per BDS EN 12644-1:2001+A1:2008;
- Maintenance and Repair Procedure for the electrical part;
- Procedure for Installation and Commissioning of the FHM with the new FHM CS.

A list of the codes and standards used in the design shall be attached.

2.2.4 I&C Part

It covers requirements to the design of the I&C systems, registration and monitoring systems, etc. Its scope shall comply with i. 2.4 and Chapter 11 of Regulation No. 4 on the investment projects' scope and content.

• A video connection shall be established between the FHM control panel and rooms 5, 6A1015, by means of installing visual display units to visualise the data from the camera display.

2.2.5 WSS (Water-Supply and Sewerage) Part

Not applicable.

2.2.6 HSHVAC (Heat Supply, Heating, Ventilation, and Air-Conditioning) Part

Not applicable.

2.2.7 Energy Efficiency Part

Not applicable.

2.2.8 Geodetic Surveying Part (layout plan and vertical levelling)

Not applicable.

2.2.9 Mechanical Part

This part of the Design shall cover:

• Procurement of an upgraded gripper assembly for reliable engagement/disengagement as well as to prevent hang-ups;

• Procurement of a complete bridge drive in order to facilitate an increase in bridge speed of motion thus reducing the time for refuelling;

• Procurement of a complete carriage drive in order to facilitate an increase in carriage speed of motion thus reducing the time for refuelling;

• Replacement of the fixed mast and turntable rotation drive;

• Procurement of modified seismic supporting structures with a permanent magnet and inductive sensor;

• Procurement and installation of a new adjustable pull force meter for the fixed mast lifting winch (in order to increase the main rope operating life);

• Replacement or preservation of existing air supply and sampling lines of the fuel rod cladding integrity surveillance systems - 5, 6PP70. Preserve the air supply nozzles unit. The connection points of the air supply and sampling lines to the process part of systems 5, 6PP70 shall be installed on the FHM carriage;

• Laying of a cable conductor to provide for greater rotation angle;

• Procurement of a fixed mast kit (with spare parts and tools - SPT);

• Procurement of a telescopic mast kit (SPT);

• Reconsideration of the SPT kit, procurement of a new kit.

It is necessary to submit the calculations (dimensions and/or verifications) for all the load combinations (including seismic load) of the FHM with newly installed equipment. The seismic

loads in 5,6ГА701, the locations of the FHMs, are provided in Attachment 1 of the ToR – Specification of the Seismic Requirements for Equipment, No. Сп.ХТС 22/09.06.2021.

2.2.10 Traffic Organisation and Safety Part

Not applicable.

2.2.11 FS (Fire Safety) Part

The scope and content of the FS Part are defined in Attachment 3 of Regulation No. Із-1971 of 29.10.2009 on the construction and engineering codes and standards ensuring safety in the event of a fire.

The requirements stipulated in this part shall be harmonised with the Regulation on Ensuring the Safety of Nuclear Power Plants.

2.2.12 SHP (Safety and Health Plan) Part

The Contractor shall prepare a SHP in compliance with Regulation No. 2 of 22.03.2004 on the Minimum Requirements to Healthy and Safe Labour Conditions in the Course of Construction and Installation Works.

The SHP Part shall cover installation requirements, schedule and conditions for installation during outage, operation, etc., as well as estimated deadlines, test and commissioning conditions.

2.2.13 Plan for the Construction Waste Management Part

Not applicable.

2.2.14 Radiation Protection Part

The FHMs and some of their components subject to this ToR are located within the Kozloduy NPP controlled area.

The Design shall comply with the Regulation on Ensuring the Safety of Nuclear Power Plants, regulations based on the Safe Use of Nuclear Energy Act (SUNEA) as well as with the rules and regulations currently effective at Kozloduy NPP – Procedure for Radiation Protection at Units 5 and 6 of Kozloduy NPP EAD, No. 30.ОБ.00.РБ.01, based on the Regulation on Radiation Protection (adopted by CM decree No. 20 of 14.02.2018).

2.2.15 SAR (Safety Analysis Report) Part

An analysis shall be performed of the refuelling process and additional requirements and recommendations shall be defined in order to ensure the refuelling process safety thus harmonising the modernised FHM with the current (updated) safety regulations (Russian and international). The scope of safety regulations shall be defined as part of the implementation of the Modernisation Project. The assessment of the SAR shall be harmonised with the Regulation on Ensuring the Safety of Nuclear Power Plants. An example of the safety assessment is presented in ПНАЭ Г-01-036-95 “Требования с содержанию отчёта по обоснованию безопасности АС с реактором типа ВВЭР” (Requirements to the content of the Safety Analysis Report for NPPs with WWER-1000 reactors).

2.2.16 Software Part

Procure the system and application software, on a digital medium, for the programming and configuration of the relevant devices (controllers and transducers), along with the required operational licences. An application software listing shall be provided on a digital medium. A detailed managing algorithm shall be provided in a text format. The required servicing computers to manage the above software supporting the control system shall be procured.

The upgraded software shall perform at least all the functions of the existing system during all the design operating modes;

The Contractor (Designer) shall prepare a description of the software protection interlocks used in the design;

The above software description shall be prepared in compliance with the Quality Assurance Procedure for Ordering, Development, and Installation of Software, ДОД.ОУ.ПОК.218.

2.2.17 Other Design parts

Taking into account the specific nature of the projects for nuclear power plants, additional design parts may be required, out of the scope of Regulation No. 4 of 21.05.2001 on the investment projects' scope and content.

2.3. Requirements to the content of the Design parts

For each of the Design technological parts, the Contractor shall submit the following:

Explanatory note – describing the approved design modification, approved operating modes, layout solutions, etc.

The notes are prepared as per the scope defined in Chapters 8 to 17 of Regulation No. 4 of 21.05.2001 on the investment projects' scope and content;

Interactions with the existing design – describing the battery limits which shall be clearly defined based on a specific list of elements delimiting the design scope. The battery limits shall be defined as per the actual state of the systems.

The additional requirements to the interactions with the existing design, if any, shall be defined in details;

Calculations – calculations justifying the design modifications in terms of reliability, strength and seismic resistance. A justification of design functionality during all operating modes and transients shall be included. The equipment condition inspection (verification) shall also be covered;

Drawings, diagrams, and graphs – graphic representations of approved design modifications facilitating the installation works, process plans and diagrams, sections and axonometric projections. Mechanical design drawings of complicated and unlisted nodes shall be included;

Specifications – A technical specification of the components to be procured shall be submitted;

Quantity surveys - Quantity surveys listing all the construction works and start-up operations required for implementation of the new design shall be submitted.

The quantity surveys shall be prepared using codes of the Building Manager application or based on CLR (construction labour rates), CCR (consolidated calculation rates), UERC (unified engineering rates in construction) and AEC (Association for Electronic Communications) for the individual types of works, while for the works not considered in them, analyses with specified quantitative labour, mechanisation, and material costs shall be conducted.

The quantity surveys and technical specifications shall be prepared separately for all parts of the Design;

List of codes and standards – list of all codes, standards and other documents used in the system and equipment design.

The Design shall meet the requirements of the Kozloduy NPP current regulations and technical specifications:

• Regulation No. 2 on the minimum requirements to healthy and safe labour conditions in the course of construction and installation works, 2004;

• Safe Use of Nuclear Energy Act, 2002;

• Regulation No. 4 of 21.05.2001 on the investment projects' scope and content, 2004;

•Regulation No. 8121з-647 of 1.10.2014 on fire safety rules and norms during operation of facilities;

• General provisions for the safety of nuclear power plants, НП-001-15;

• Standards for design of seismic resistant nuclear power plants, НП-031-01, 2002.;

• Safety rules for storage and transportation of nuclear fuel at nuclear facilities, НП-061-05, (supersedes ПНАЭГ-14-029-91);

• Nuclear safety rules for reactor facilities of nuclear power plants, НП-082-07, (supersedes ПБЯ РУ АС-89);

• ASME NOG-1-2015 „Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)";

• Rules for the design and safe operation of load-lifting machines and mechanisms used at nuclear power facilities, НП-043-18;

• NSI/AISC N690-06 "Specification for Safety-Related Steel Structures for Nuclear Facilities";

• Regulation No. 9 on the technical operation of power plants and grids, 2004;

• Regulation on the safe operation and technical supervision of lifting equipment, 2010;

• Regulations for health and safety at work in electric installations of electricity and heat generation power plants and on electrical grids, 2004;

• Regulations for health and safety at work in non-electric installations of electricity and heat generation power plants and on heat networks and hydro engineering facilities, 2005;

• Industrial safety rules for welding and cutting of metals, 1999;

• BDS EN 62040-2.2018 - Uninterruptible power supply systems (UPS). Part 2 - "Electromagnetic compatibility requirements" (EMC) (IEC 62040 - 2:2016);

• Regulation No. Із – 1971/2009 on the construction and technical codes and standards ensuring fire safety.

The Contractor may also use additional regulations whose selection shall be justified in the design documentation.

In the course of the design, the Contractor shall observe the relevant laws and regulations independently of whether or not specified in the ToR.

Each reference to a standard in this ToR shall be interpreted as "or equivalent/and"

3. Requirements for the supply of equipment and materials

The basic supply requirements are included in the developed design as per item 2. This item covers all the known and potential requirements to the characteristics of equipment and materials.

3.1. Equipment classification

Safety class of the fuel handling machine – 4H as per НП-001-15 "Общие положения обеспечения безопасности атомных станций" (General provisions for the safety of nuclear power plants);

Quality class of the fuel handling machine – **SL-1** as per List of Units 5 and 6 structures, systems and components classified for safety, seismicity and quality, ID.No.30.ОУ.00.СПН.02/2.

The video system, which is part of the fuel handling machine, is classified as **4-H** class as per НП-001-15 „Общие положения обеспечения безопасности атомных станций" (General safety regulations for nuclear thermal power plants).

3.2. Seismic resistance category

The fuel handling machines are categorized as **seismic category 1 (one)** as per НП-031-01, 2002 "Нормы проектирование сеисмостойких атомных станций" (Design norms for earthquake-proof nuclear power plants).

The transmission part of the video system is categorised as equipment of **seismic category 2 (two)** as per Design norms for earthquake-proof nuclear power plants. НП-031-01.

3.3. Equipment qualification

3.3.1. Seismic resistance qualification of the equipment

According to item 2.9 of НП-031-01, the equipment of seismic category 1 shall:

- retain its capability to perform its functions related to ensuring the safety of NPP during and after a safe shutdown earthquake;

- retain its operability during an OBE, including after the earthquake.

The seismic stability of the equipment should be proved in compliance with the currently effective regulatory documents applicable to NPP, as follows:

- НП-031-01 “Нормы проектирования сейсмостойких атомных станций” (Standards for design of seismic resistant nuclear power plant);

- IEC/IEEE 60980-344 “Nuclear facilities – Equipment important to safety – Seismic qualification”, 2020;

- ASME NOG-1-2015 „Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)”;

- НП-043-18 “Правила устройства и безопасной зксплуатации грузоподъемннх машин и механизмов, применяемьгх на объектах использования атомной знергии” (Rules for the design and safe operation of load-lifting machines and mechanisms used at nuclear power facilities);

- -IEEE 420-2013 – Standard for the design and qualification of class 1E control boards, panels, and racks used in nuclear power generating stations;

- -IEC 60034-14 “Rotating electrical machinery Part 14. Mechanical vibration of certain machines with shaft heights 56 mm and higher. Measurement, evaluation and limits of vibration severity”;

-ANSI/AISC N690-06 “Specification for Safety-Related Steel Structures for Nuclear Facilities”;

- ПНАЭ Г 7-002-86 “Нормы расчета на прочность оборудования и трубопроводов атомных энергетических установок” (Norms for strength calculations of equipment and pipelines on nuclear power facilities);

- ГОСТ 7516.1-90 “Общие требования в части стойкости к механическим внешним воздействующим фактором” (General requirements with respect to resistance to external mechanical effects);

- ГОСТ 30546.2 “Испытания на сейсмостойкость машин, приборов и других технических изделий (Seismic stability tests for machines, instruments and other industrial products). General guidance and test methods”;

- ГОСТ 30630 “Методы испытаний на стойкость к внешним воздействующим факторам машин, проборов и других механических изделий” (Environmental resistance test methods for machines, instruments and other industrial products);

- РД 25818-87 “Общие требования и методы испытаний на сейсмостойкость приборов и средств автоматизации, поставляемых на АЭС” (General requirements and methods of performing seismic stability tests of instruments and automation devices supplied to NPPs).

**Note: When using the seismic impact as per ГОСТ 17516, ГОСТ 30546, ГОСТ 30630 or РД 25818-87, it is necessary to prove the applicability of the impact used for the place of installation of the cabinets at Kozloduy NPP according to the procedure described in item 5.3.4 of the Specification.*

The use of other normative documents shall be justified.

3.3.2. The fuel handling machines are not classified as equipment of the systems needed for the safe shutdown according to the “List of qualified equipment (safe shutdown equipment)”, 30.ПП.00.СПН.008.

3.3.3. The fuel handling machines are installed in rooms 5,6ГА701 in the containment of the reactor building at elevation 36,90.

3.3.4. The rooms in which the fuel handling machines are installed are of **Ф5Д** functional fire hazard class and **normal fire hazard** class for electric appliances and installations in this compartment in compliance with the “Regulation No. I3-1971 of 29.10.2009 on construction and technical rules and standards to ensure fire safety”.

3.3.5. The rooms are of radiation protection category **1*** in compliance with the requirements of “Regulation on the radiation protection during activities with sources of ionizing radiation” and “Radiation protection procedure at Units 5 and 6 of Kozloduy NPP EAD, 30.ОБ.00.РБ.01/*.

3.3.6. The fuel handling machines shall retain their functions and shall be operable after being exposed to the following environmental condition in the containment, excluding the equipment and systems which are dismantled during the power operation of the reactor unit:

During normal operation (outside the outage timeframes):

- Temperature – from 15 to 60˚C;
- Humidity – up to 90%;
- Normal pressure (absolute) – 0.87 ÷ 1,05 kgf/cm^2;
- Volumetric activity, normal – ≤ 7,4x107 Bq/m^3.

3.3.7. Requirements for the video system (based on the STC-FHM-100)

The video system (based on the STC-FHM-100) shall be II design group regarding the resistance to electromagnetic disturbances and compliant with criteria C for functioning quality according to ГОСТ 32137-2013 or an equivalent.

The equipment at the broadcasting side of the video system shall correspond to class 2.1 in compliance with ГОСТ 25804.3-83 or equivalent, and the equipment at the receiving side – class 3.

Regarding the protection of service personnel from the electric shock, the video system shall correspond to the following classes in compliance with ГОСТ 12.2.007.0-75 or equivalent: broadcasting part – class 0, video display – class OI, video system set and the device for information recording and storage – class I, the rest of equipment – class III.

The equipment at the broadcasting side and the coupling cable shall be resistant to the impact of 0,2 MPa hydrostatical pressure, and to be resistant to ionizing radiation with dose rate correspondingly:

Working dose rate of γ-radiation not more than 3.105 rad/h (3.103 Gy/h);

Integral dose of γ-radiation not more than 2.107 rad (2.105 Gy).

The protection class rating of the external cover at the broadcasting side and coupling cable shall be IP68, and at the receiving side not less than IP20 in compliance with ГОСТ 14254-96 or equivalent.

The materials and equipment external cover at the broadcasting side shall be resistant to the impact of the following decontamination solutions with temperature from 90º to 95º C:

I solution:

- sodium hydroxide (NaON) – 30-40 g/l
- potassium permanganate (KMnO4) – 2-4 g/l

II solution:

- oxalic acid (H2C2O4) – 10-30 g/l
- hydrogen peroxide (H2O2) – 0,5 g/l or nitric acid (1 g/l).

The video system shall be considered part of the instrumentation for multiple cyclic usage with uninterrupted functioning period 24 hours.

The video system shall maintain reliable functioning during its average useful life and ensure uninterrupted work regardless of number of starts or returns to service.

3.4. Physical and dimensional characteristics

All the physical and dimensional characteristics are as per Technical datasheet “Fuel handling machine type МПС-В-1000-3М-У4.2_AG-17000-G1-1-6” and Technical specifications AG-17000-MK-2-6.

3.5. Material properties

Materials used for production of structural elements of the fuel handling machine shall comply with the design and technology documentation of the manufacturer, and all the current codes and standards for this type of items shall be met to ensure complying with the requirements of item 3.8 for the validity and lifetime period.

3.6. Chemical, mechanical, metallurgical and/or other properties

The quality and properties of materials and semi-manufactured goods delivered for manufacturing of items which will be replaced during the modernisation of fuel handling machines

5,6PL00E01 type МПС–В–1000–3М–У 4.2 shall comply with the requirements of the corresponding standards and technical specifications, and this shall be confirmed with the corresponding certificates issued by the supplier. If the certificate data is incomplete, the Contractor shall verify the material quality in compliance with the corresponding standards, technical specifications for the production and drawings.

The results of the tests and studies shall be drawn up in compliance with the requirements of the manufacturer of the fuel handling machines.

3.7. Conditions for operation in ionizing radiation environment

3.7.1. The delivered equipment installed in the containment, subject to this Terms of Reference, shall work in ionizing radiation environment and shall meet the requirements as follows:

During normal operation in containment the environmental conditions shall be as follows:

- Temperature – up to 60°C /including/;
- Pressure – from 0.085 to 0.103 MPa /including/;
- Relative humidity - up to 90% /including/;
- Absorbed dose rate – up to 1 Gy/h /including/ for the entire period of operation;
- Volumetric activity – up to 7.4x107 Bq/m^3 /including/.

The delivered equipment installed outside the containment shall meet the following requirements:

- Temperature – from 10 to 27ºC /including/;
- Pressure – from 0.085 to 0.103 MPa /including/;
- Relative humidity – up to 80 % /including/.

3.7.2. The fuel handling machine video system (based on the STC-FHM-100) shall work reliably and without defects under the following conditions:

- working medium of the broadcasting side – water, water process medium (distilled water with content and concentration of boron acid in the spent fuel pools 5,6TG21B01,02,03 – up to 20 g/kg and 1 % of sodium thiosulfate);
- temperature of the working medium from 10ºC to 60ºC;
- absorbed dose of γ radiation (Co60), not more than 2x105 Gy (rad);
- dose rate of γ radiation, not more than 0,8 Gy/s (3x105 rad/h).

3.8. Requirements to the shelf-life and service life

The service life shall be at least 30 years from the commissioning date.

3.9. Additional characteristics

Not applicable.

3.10. Requirements to the delivery and packaging

3.10.1. Requirements to the delivery

• All the components and parts of the equipment shall be delivered to Kozloduy NPP EAD with packaging that protects them from damage caused by environmental conditions during the transportation and in the course of loading and unloading operations. The equipment shall comply with the detailed design described in the Terms of reference and approved by the Contracting authority at a specialised technical council. The delivery shall be received in compliance with the general incoming inspection as established at Kozloduy NPP, pursuant to Quality procedure for conducting incoming inspection of the supplied raw materials, materials, and additional assembly items at Kozloduy NPP, 10.УД.00.ИК.112.

• In case unfitness of the entire lot or of a part of it is identified during the general incoming inspection of the delivered materials, the Contractor delivers new materials using his/her own resources and at his/her own expenses;

• Place of delivery – Kozloduy NPP;

• The delivery shall be effected at least 45 days before the outage of the corresponding unit;

• The delivery of materials and consumables, needed for the activities planned in the projects, is included in the Contract scope. During the implementation of the activities, the Contractor shall use materials and consumables with certified origin. These materials shall be subject to incoming inspection as established at Kozloduy NPP.

3.10.2. Packaging requirements

• The packaging shall not allow any damages during transportation, in the course of loading and unloading operations and during storage.

• All the assemblies, components and parts of the equipment shall be delivered to Kozloduy NPP EAD with packaging that protects them from damage caused by environmental conditions during the transportation and in the course of loading and unloading operations. No breach of the mechanical integrity and surface damage of the equipment shall be allowed.

• The package and large size parts shall be equipped with gripping devices for lifting and moving.

• The package type shall comply with the requirements for transportation to and storage at the warehouse management of Kozloduy NPP, as well as transportation to the place of installation.

3.11. Loading and unloading activities

The package of delivered equipment shall allow implementation of mechanised loading and unloading operations and lot storage for the warranty period (to ensure the required protection against damage during transportation, unloading and storage).

3.12. Transportation

The equipment shall be transported in compliance with the manufacturer's requirements by closed top transport under specified environmental conditions.

3.13. Storage conditions

The Contractor shall provide information on terms and conditions for the storage of delivered equipment.

4. Requirements to the manufacturing

4.1. Rules, standards, production and testing documents

The technological sequence of activities and all the requirements of the process and regulatory documents of the Manufacturer shall be met. All the tests and control activities (incoming inspection of the materials, tests during manufacture, acceptance tests, etc.) shall be performed in compliance with the process and regulatory documents for the corresponding type of items, and in compliance with the following documents:

- НП-031-01 “Нормы проектирования сейсмостойких атомных станций” (Standards for design of seismic resistant nuclear power plant);

- IEC/IEEE 60980-344 “Nuclear facilities – Equipment important to safety – Seismic qualification”, 2020;

- ASME NOG-1-2015 “Rules for construction of overhead and gantry cranes (Top running bridge, multiple girder)”;

- НП-043-18 “Правила устройства и безопасной зксплуатации грузоподъемннх машин и механизмов, применяемьгх на объектах использования атомной знергии” (Rules for the design and safe operation of load-lifting machines and mechanisms used at nuclear power facilities);

- IEEE 420-2013 – Standard for the design and qualification of class 1E control boards, panels, and racks used in nuclear power generating stations;

- IEC 60034 “Rotating electrical machinery”;

- ANSI/AISC N690-06 “Specification for Safety-Related Steel Structures for Nuclear Facilities”;

- ПНАЭ Г 7-002-86 “Нормы расчета на прочность оборудования и трубопроводов атомных энергетических установок” (Norms for strength calculations of equipment and pipelines on nuclear power facilities);

- ПНАЭ Г-01-036-95 “Требования с содержанию отчёта по обоснованию безопасности АС с реактором типа ВВЭР” (Requirements to the content of Safety Analysis Report of a NPP with WWER-1000 reactor);

- ГОСТ 7516.1-90 “Общие требования в части стойкости к механическим внешним воздействующим фактором” (General requirements with respect to resistance to mechanical external influences);

- ГОСТ 30546.2 “Испытания на сейсмостойкость машин, приборов и других технических изделий (Seismic stability tests for machines, instruments and other industrial products). General guidance and test methods”;

- ГОСТ 30630 “Методы испытаний на стойкость к внешним воздействующим факторам машин, проборов и других механических изделий” (Environmental resistance test methods for machines, instruments and other industrial products);

- РД 25818-87 “Общие требования и методы испытаний на сейсмостойкость приборов и средств автоматизации, поставляемых на АЭС” (General requirements and methods of performing seismic stability tests of instruments and automation devices supplied to NPPs);

- Regulation No. 2 on the Minimum requirements to healthy and safe labour conditions in the course of construction and installation works”, 2004;

- Safe Use of Nuclear Energy Act, 2002;

- “Regulation No. 4 of 21.05.2001 on the scope and content of the investment projects”, 2004;

-“Regulation No. 8121з-647 of 1.10.2014 on Fire safety rules and norms during operation of facilities”;

- “General provisions for the safety of nuclear power plants” НП-001-15;

- НП-031-01 “Design norms for earthquake-proof nuclear power plants”, 2002;

- “Safety rules for storage and transportation of nuclear fuel at nuclear facilities” НП-061-05, (cancels and replaces ПНАЭГ-14-029-91);

- “Nuclear safety rules for reactor facilities of nuclear power plants” НП-082-07, (replaces ПБЯ РУ АС-89);

- NSI/AISC N690-06 “Specification for safety-related steel structures for nuclear facilities”;

- “Regulation No 9 on the technical operation of electric power plants and grids”, 2004;

- “Regulation on the safe operation and technical supervision of lifting equipment”, 2010;

- “Safety rules at work in electrical installations of power generating and heat generating plants and in electrical grids”, 2004;

- “Safety rules at work in non-electrical installations of power generating and heat generating plants and in heat distribution and hydro engineering facilities”, 2005;

- “Industrial safety rules for welding and cutting of metals”, 1999;

- БДС EN 62040-2.2018 – Uninterruptible power supply systems (UPS). Part 2 – “Electromagnetic compatibility requirements” (IEC 62040 - 2:2016);

- „Regulation No. Iз-1971/2009 on Construction and technical rules and standards to ensure fire safety”.

4.2. Testing of products and materials during manufacturing

The following activities, specified by the Manufacturer, shall be performed during manufacturing: incoming inspection of the used materials, tests and acceptance tests.

The Contractor shall be obliged to coordinate in due time with the Contracting authority any change in the structures, the characteristics of the parameters and the test conditions, influencing the test results.

The test results are documented by filling corresponding records.

4.3. Control by Kozloduy NPP during manufacturing

The control activities and tests performed during manufacturing shall be recorded in compliance with the requirements of the manufacturer plant and process documentation.

4.4. Safety measures against contamination with radioactive substances and dangerous products

As per requirements of item 2.2.14.

4.5. Responsibilities during startup

All discrepancies and changes that have occurred during installation, commissioning and functional tests shall be reflected in the detailed design and entered in the as-built documentation.

The Contractor shall ensure presence of a competent representative of Ganz EEG Kft manufacturer plant (successor of Ganz-MÁVAG) in order to carry out designer supervision and provide support during operation.

4.6. Conditions of surfaces and coatings

As per requirements of the manufacturer plant for the separate items needed for the modernisation of fuel handling machines.

4.7. Safety conditions

As per basic safety requirements included in Safety and Health Plan part of the project under item 2.

5. Requirements for the construction activities

The implementation of construction and installation works in accordance with the schedule, drawn up by the Contractor and approved by the Contracting authority, will start after acceptance of the detailed design by the Expert Technical Council without comments, conducting incoming inspection of main equipment and materials, filling an incoming inspection report without comments, and signing a report for providing access to the work site and authorising work, if the Contracting authority has technical opportunity.

All the activities under this ToR are performed in the ***Radiation Controlled Area (RCA)*** of units 5 and 6 – area at Kozloduy NPP site with controlled access for performing activities in an environment with sources of ionizing radiation.

5.1. Supervision of the construction and installation works

5.1.1. Investor control in terms of implementation, acceptance, supervision, coordination and reporting of work done by Contracting authority will be performed by the Investment Division.

5.1.2. The technical control by the Contracting Authority will be carried out by EP-2 (Units 5 and 6).

5.2. Implementation plan for the CIW

The period is identified in which the work can be performed (during outage, apart from outage, irrespective of the outage). The document which gives permission for starting work is specified, and it determines the initiation of works (contract, report on contractual documentation review in compliance with Annex No. 5 of ДБК.КД.ИН.028, report model No. 2 from Regulation No. 3 of 31.07.2003 on compiling acts and reports in the course of the construction, report for providing access to the work site and authorising work, etc.). Indicative deadline for implementation and interim stages for activities submitting are specified, if needed.

Implementation schedule for the activities shall be prepared, as appropriate, which should include the individual stages, activities, deadlines for their implementation and the resources necessary. The schedule shall also include the activities performed by Kozloduy NPP EAD, which affect the implementation of the activity by the Contractor. The critical path is also specified for more complex and long-term activities.

The preparation of schedule may be assigned to the Contractor, with mandatory approval by Kozloduy NPP EAD.

The schedule is updated during the implementation of construction works, if needed.

5.3. Conditions and activities to be performed by Kozloduy NPP EAD

The Contracting Authority ensures access to work to the staff of the Contractor, in accordance with the Quality Procedure. Work performed by contractors, ДБК.КД.ИН.028.

5.4. Conditions and activities to be performed by the Contractor

5.4.1 The Contractor shall develop a detailed design containing final design modification with clearly identified battery limits and design functions description.

5.4.2. The Contractor shall implement the approved detailed design.

5.4.3. The Contractor shall draw up and agree with the Contracting authority the needed records, certificates and other documents related to activities implementation.

5.4.4. The Contractor shall follow the procedure and meet the requirements specified in the internal documents in force at the site being served: Occupational health and safety at work, Radiation protection, Nuclear safety, Fire safety and Environmental protection.

5.4.5. Follow the required installation instructions for the new equipment.

5.4.6. Use special tools, devices and measurement instruments which are tested and/or calibrated.

5.4.7. Deliver materials and products to be used during implementation of activities. These materials and products shall be subject to incoming inspection as established in Quality Procedure.

Conduct of incoming inspection of the supplied raw materials, materials and additional assembly items at Kozloduy NPP, ID No. 10.УД.00.ИК.112/*.

5.4.8. Provide declarations/certificates of conformity and origin (declaration of performance) for the used items, materials and consumables, required by the relevant regulations for essential requirements. All the documents shall be submitted in Bulgarian.

5.4.9. He/she is responsible for the personnel safety during implementation of contract activities.

5.4.10. Comply with the deadlines specified for the implementation of activities as per schedule.

5.4.11. The Contractor shall notify the Contracting authority about non-conformances that occur during the implementation of construction and installation works.

5.4.12. The Contractor shall submit a detailed bill of quantity for the corresponding part after completing a stage from the implementation of the planned activities.

5.5. Installation and commissioning

The Contractor works following an approved design. The modifications in the approved design are documented and are subject to review and approval. The designer issues an order which is recorded in the construction order book.

Following the dismantling of the old equipment and installation of the new one, the housekeeping in the rooms (floors, walls, support structures, etc.) where the construction and installation works were implemented shall be restored at the expense of the Contractor.

The submission of the dismantled equipment to the warehouse at Kozloduy NPP EAD shall be performed by the Contractor in compliance with the current rules.

The dismantling of the existing equipment shall be performed in a way that allows its reuse.

Damages caused by the Contractor shall be repaired by the Contractor at his/her expenses. The Contractor shall ensure daily cleaning of the workplace.

6. Requirements for other activities necessary for the execution of the order

Not applicable.

7. Regulatory and technical documents applicable to construction and installation works and commissioning

When performing installation works and commissioning of the supplied equipment, the following regulatory and technical documents shall be followed:

- Quality Procedure. Work performed by contractors, ДБК.КД.ИН.028;

- Quality procedure for conducting incoming inspection of the supplied raw materials, materials, and additional assembly items at Kozloduy NPP EAD, ДОД.КД.ИК.112;

- Safety rules at work in non-electrical installations of power generating and heat generating plants and in heat distribution and hydro engineering facilities, 2004;

- Regulation No. 2 of 22.03.2004 on the Minimum requirements to healthy and safe labour conditions in the course of construction and installation works;

- Regulation No 9 of 09.06.2004 on the technical operation of electric power plants and grids;

- Safety and health at work act;

- Regulation No. 3 of 31.07.2003 on Compiling acts and records in the course of the construction;

- Regulation No. Із-1971 of 29.10.2009 on Construction and technical rules and standards to ensure fire safety.

- Other applicable current regulatory documents in Republic of Bulgaria.

8. Documents required upon delivery, installation and commissioning

8.1. The documents accompanying the delivery shall be submitted on paper in one copy in the original language, 1 copy in Bulgarian language and a CD that contains: files in the original format for preparation of the documents and .pdf files created using scanning equipment - 1 copy. Certificates, reports and declarations shall be submitted in the original language with a Bulgarian translation done by a licensed translator. The translation of documents must be signed by the translator and certified according to the current national legislation.

The documents required upon delivery of equipment and materials and the documents required for installation, operation and maintenance are:

- a passport that contains: name of the item, factory number, production date and manufacturer, item specifications, component description and parameters;

- operating procedure with guidelines for maintenance and repair in Bulgarian (translation) which should include at least the following: criteria for performing maintenance, maintenance and repair periodicity requirements, specific installation and dismantling requirements, technical maintenance and repair activities and their periodicity following the expiry of their operating life (paragraph 3.8), as well as terms and conditions for the extended period of operation;

- drawings - general and detailed drawings and technical requirements;

- test reports;

- equipment seismic qualification report according to the requirements of the ToR, Attachment 1 (Specification of the seismic requirements for equipment №Сп.ХТС 22/09 June 2021. The seismic qualification documents shall be submitted at least a month before the delivery;

- declarations/certificates for compliance (Declarations of Performance, declarations for the specifications of a construction product) together with the accompanying quality certificates and Declarations of Origin/Certificates of Origin of equipment, materials and consumables, construction materials used, machines, electrical facilities and other items required by the current legislation in the Republic of Bulgaria;

- strength calculations with consideration of the seismic load;

- calibration record/certificate or records to check the measuring devices used and special tools, etc.;

- a document describing the storage conditions and service life;

- warranty card;

- procedure: for control, measurement, calibration;

- a list of the deviations found during the manufacturing process.

8.2. For the reason that it takes a long time to produce the items, technical passports for identical or similar equipment delivered for a nuclear power plant that are defined in this section shall be submitted as part of the proposal for participation in tenders (before conclusion of a contract).

8.3. While performing installation works, the Contractor has to use a construction order book when making investments, according to Article 7, paragraph 3, item 4 of Regulation No. 3 as of 31 July 2003, to issue certificates and records during the construction and to enter in it the changes in the design during the construction and installation works. In case of any design modification, an order is issued which is then registered in the construction order book. After work is completed, the construction order book is submitted to be archived together with the other document deliverables.

9. Input data

9.1. The Contractor shall prepare and submit a list of the input data he needs for the implementation of the activities regarding this Terms of Reference.

9.2. The Contracting Authority, after checking and assessing the list, gives the Contractor the available input data.

9.3. Input data are sent to the Contractor after conclusion of the contract in the form and format present at the Kozloduy NPP EAD under Quality Procedure. Submitting input data to contractors, ДОД.ОК.ИК.1194.

9.4. If input data are unavailable, the Contractor develops them at their own expense with the help of the Contracting Authority.

9.5. The input data needed which are not available in documents shall be taken by the Contractor in situ, through walkdowns and survey of the current condition, while observing the requirements for assuring access to the NPP site pursuant to Quality Procedure. Work for contractors, ДБК.КД.ИН.028.

10. Receiving inspection

10.1. Receiving inspection shall be performed on the site of Kozloduy NPP under Procedure for carrying out Receiving inspection of supplied materials, raw materials and accessories at Kozloduy NPP, ID. No. 10.УД.00.ИК.112/*.

10.2. Should any non-conformances be identified during the receiving inspection, they shall be fixed at the expense of the Contractor.

11. Contact deliverables

The current Terms of Reference provides the reason for performing the modernisation needed that encompasses the main requirements of the Contracting Authority and it can be attached to the contract for activities implementation.

11.1. At the Design stage:

After the Design stage is completed, the Contractor shall submit

A detailed design with scope and contents according to the requirements of item 2 of this Terms of Reference.

11.2. At the Delivery stage:

Upon delivery of the equipment necessary to perform the actions for modernisation, the Contractor shall submit:

• Technical passports of the equipment and sectional and detailed drawings;

• Procedure for installation with assembly drawings;

• Operating procedure with a description of the principle of operation of the new equipment, requirements for its operation, possible malfunctions, ways, methods and means for their removal;

• Procedure for maintenance and repair with periodicity description and the activities performed for technical maintenance;

• Schedule and procedure for the handover testing and complex testing;

• Training schedule and plan;

• Bill of lading;

• Invoice;

• Packing list;

• Certificates of Origin of the equipment and certificates for the materials used;

• Declaration of conformity with the technical documentation issued from the manufacturer;

• Declaration of Conformity with EU Directive for the essential requirements for products;

• Declaration of Conformity with specialised state or European standards for such equipment.

11.3. At the Project implementation stage:

The project implementation includes all activities related to dismantling and installation of new equipment.

Documenting the dismantling and installation works shall be done according to the requirements of Quality procedure. Organisation and control during installation of equipment and pipelines, 30.ОУ.ОК.ИК.25 and Regulation No. 3 on issuing certificates and records in the construction process and they should include at least the following:

• Completed Quality Plans with hold points;

• Completed construction order book;

• As-built documentation;

• Certificates for completion of dismantling and installation works;

• Certificates for completion of dismantling and installation works;

• Certificate for functional testing (issued in cooperation with Units 5 and 6);

• A record of conducted personnel training;

• Others, not specified above, that take into account the separate installation works;

• Records for conducted start-up and commissioning activities.

The installation activities shall be considered finished after completion of complex functional tests verifying compliance with the specifications set in the design and submission of as-built documentation and a full package of documents.

12. Acceptance criteria for the works

12.1. The design activities shall be considered completed after review and acceptance by Kozloduy NPP EAD of the detailed design and approval of a report issued by the Contractor's Expert Technical Council (ETC);

12.2. The Contractor is liable to ensure at his own expense the presence of his own competent personnel to the working meetings and technical expert panels conducted on the site of Kozloduy NPP EAD.

12.3. The delivery activities are considered completed after successful general receiving inspection, according to the established procedure in Kozloduy NPP EAD, compliant to Quality Procedure. Conducting receiving inspection of the supplied raw materials, materials, and additional assembly items at Kozloduy NPP EAD, ДОД.КД.ИК.112 and signed receiving inspection report without non-conformities;

12.4. Successful set-up, tests and commissioning of the modernised FHM in compliance with programs prepared by the Contractor and approved by the Contracting Authority and signed after acceptance of construction and repair works and start-up and commissioning works.

12.5. Submitted as-built documentation.

12.6. A report for CIW completion is Work completion report, according to Quality procedure. Preventive maintenance and repair of structures and components from process systems at Units 5 and 6, 30.ОУ.ОК.ИК.40 on hardcopy.

13. Quality assurance requirements

13.1. Contractor management system (MS)

13.1.1. The supplier shall apply a certified management system as per BIS EN ISO 9001:2015, 'Quality Management System. Requirements' or equivalent, with a scope covering the activities under this ToR, and shall present a copy of a valid certificate.

13.1.2. The Contractor shall notify Kozloduy NPP EAD of any structural changes or changes in the MS documentation related to the activities performed under the contract.

13.2. Quality Assurance Programme (QAP)

The Contractor shall prepare and submit to the Safety and Quality Directorate a Quality Assurance Program (QAP) for the stages in the (design/supply/installation and commissioning) within the scope of this Terms of Reference (ToR) within 20 (twenty) calendar days of signing the contract. The programme shall serve to determine a detailed schedule, the responsibilities for performing each of the tasks under the contract and the order for their implementation. The programme shall be reviewed and approved by the Contracting Authority as a precondition for initiation of the activities under the contract. The QAP shall be developed on the basis of:

- the Terms of Reference and the Contract;
- the Contractor's quality management system;
- other standards and regulations related to the activities within the scope of the ToR;
- the QAP shall be prepared with sample QAP content provided by the Contractor.

In the QAP, references can be made to internal documents of the Contractor, copies of which must be submitted to Kozloduy NPP EAD if requested.

The Contractor shall notify Kozloduy NPP EAD of any structural changes or changes in the documentation of their MS and that of the subcontractors related to the activities performed under the contract.

13.3. Quality Control Plan (QCP)

The Contractor shall prepare (as separate documents) and submit to the Safety and Quality Directorate a Quality Control Plan (QCP) to be reviewed and approved for each stage within the scope of the current Terms of Reference - design/procurement/installation and commissioning within 20 (twenty) calendar days of signing the contract and readiness for implementation.

The QCP shall be prepared as per the Kozloduy NPP EAD template.

The QCP shall include all key activities regarding the quality of the design implementation and all hold points for the Contractor and the Contracting Authority for each of the activities included in the plan. The QCP shall be reviewed and agreed by the Contracting Authority and are a prerequisite for initiation of the activities under the contract and readiness for implementation of the respective stage of the Terms of Reference scope. When reaching a hold point, the Contractor shall suspend the activities implementation until the planned control exercised by the Contractor and Kozloduy NPP EAD is performed and documented. The contractual works shall continue upon a positive control result.

The QCP with the hold points recorded shall be given to the Contracting Authority as a quality related record together with the developed design documentation.

13.4. Audit by Kozloduy NPP (Second Party Audit)

KOZLODUY NPP EAD is entitled to perform audits of the Contractors' Quality system while observing the requirements of 10.ОиП.00.ИК.049, Quality procedure. Organization and auditing of Contractors/second-party audit/". The Contractors shall confirm their consent to this condition in written.

Kozloduy NPP EAD shall be entitled to carry out inspections and checks of the activities assigned to the Contractor. The Contractors shall provide access to personnel, premises, facilities, tools, and documents used by the external organisations and their subcontractors.

13.5. Management of non-conformances

While performing installation works, the Contractor has to use a construction order book when performing activities, according to Article 7, paragraph 3, item 4 of Regulation No. 3 as of 31 July 2003, to issue certificates and records during the construction and to enter in it the changes in the design during the construction and installation works. In case of any design modification, an order is issued and then registered in the construction order book. After completion of works, the construction order book shall be submitted to be archived together with the other document deliverables.

The Contractor shall notify the Kozloduy NPP EAD of the non-conformances found during the implementation of the activities under the contract.

The Contractor has to coordinate in due time with the Contracting Authority any change in the structures, characteristics of the parameters and test conditions, influencing the test results.

The Contractor has to ensure that during the production the manufacturer has to control the non-conformances by removing and duly labelling those products whose shelf life has expired or that are subject to processing/modification to make them conform to the requirements.

The manufacturer shall keep a List of non-compliances in the course of manufacturing and, in those cases when corrective actions for modification/processing have been taken for conformance to the original specification, to ensure the Contracting Authority is notified.

Those non-conformances of products and services that require modification are reported to the Contracting Authority (the responsible person under contract/the head of the applying administrative unit where the activities are performed) to decide to dispose of the non-conforming product/service.

A list of the non-conformances with copies of these non-conformances are attached to the accompanying equipment documentation.

13.6. Professional competence (qualification) of the Contractor's personnel

13.6.1. The personnel who will work on the territory of Kozloduy NPP EAD have to possess the relevant qualification group under the Rules for Industrial Safety.

The Contractor shall provide a list of the personnel who will perform the activities with information on their education, position held and the qualification group under RHSW-EI and RHSW-NEI.

The Contractor shall have the following personnel:

- at least 3 (three) people with qualification group 4 or 5, according to RHSW-EI;
- at least 9 (nine) people with qualification group 3, according to RHSW-EI;
- at least 3 (three) people with qualification group 5, according to RSW-NEI;
- at least 9 (nine) people with qualification group 3 or 4, according to RSW-EI.

13.6.2. The Contractor's personnel who will perform activities on the Kozloduy NPP site has to be familiar with the safety culture requirements and apply them and be briefed on the effects of his actions on safety.

13.7. Quality Assurance specific requirements

13.7.1. The designation of the equipment in the design shall be performed according to the rules for assigning technological designations at Kozloduy NPP, according to the Procedure 30.ПП.00.ИК.15 Quality procedure. "Rules for assigning technological designations of structures, systems and components at Units 5 and 6"

13.7.2. Designation of the documents prepared by the Contractor shall contain the ToR index or the contract number. Each individual document shall bear a unique index set by the developer/designer and a revision number, according to the Rules for Identification of Project and Structural Documentation, Attachment 2 of Investment Control Department. Project Development Management, 30.ОУ.ОК.ИК.14. The corrections accepted in the design documentation are implemented by issuing a new revision. The full Detailed Design shall be submitted in hardcopies: in 1 (one) copy in the original language /if not Bulgarian/ and in 7 (seven copies) in Bulgarian.

13.7.3. The full Detailed Design shall be submitted in 1 copy in Bulgarian, in an electronic form in its original file format /.doc, .dwg/, as well as in a form that enables its editing at a later time if necessary, and a pdf file format with the first pages of the separate parts of the design with signatures and seals of the Designer.

13.7.4. The design shall contain a list of all design basis documents used by the Designer, clearly identified with document title or item specifying the precise requirements, and the requirements stipulated in the Terms of Reference.

13.7.5. The data from the documentation submitted by Kozloduy NPP with input data shall also be included in this list.

13.7.6. As-built documentation (detailed design) shall be prepared by the Contractor and submitted with the construction documents to the Contracting Authority in 2 hardcopies, with signatures of the participants in the construction process - up to 30 calendar days from the commissioning of the system.

13.7.7. The Contractor shall submit an updated detailed design (final as-built documentation) in 3 hardcopies and one electronic copy, in the original file format within 45 days as of approval of the draft as-built documentation.

13.7.8. Corrections in the design documentation are introduced by decision of an ETC by issuing a new revision or introducing changes (comments from the written statements) while keeping the current revision. Control over the design changes is performed by the members of the ETC, identified in the order. The control over the introduction of the changes shall be documented.

13.7.9. The software products and calculation models or analyses to be used shall be verified and certified which has to be proven with the respective documents. The design shall describe the applicability of these software products and models, use limitations and their proved applicability for the implementation of the specific task.

13.7.10. The Contractor shall submit documentation to prove that they have purchased the software used.

13.7.11. The developed design shall be subject to an independent verification by personnel of the Designer who did not participate in its development.

13.7.12. The developed design shall be subject to review and acceptance by Kozloduy NPP EAD at a session of the Expert Technical Council (ETC). The design approval by the Kozloduy NPP at a session of the ETC does not absolve the Designer of responsibility - it is only to specify the expedience and acceptability of the presented design solutions.

NOTE: For all standards specified in the Terms of Reference, technical assessments or technical references, references can be made to their equivalents.

13.8. Training of Kozloduy NPP personnel.

13.8.1. After completion of the activities under the contract, The Contractor is expected to have developed and coordinated with the Contracting Authority a training programme.

3.8.2. Training shall include:

- An introductory course that covers the modernisation of the FHM control system and the replaced equipment - a lecture;

Aspects of operation with the new equipment, typical malfunctions and troubleshooting and the most common mistakes made during operation - lecture and demonstration;

- Maintenance, troubleshooting, repair (replacement of modules), adjustment, testing.

13.8.3. Training shall be organised and conducted with personnel who are directly involved in the work of the FHM (FHMO - fuel handling machine operator, maintenance mechanics and engineers in the NF team, maintenance engineers and handling operations worker in the Electrical Equipment and Microprocessor Electronics Group from Primary Circuit Equipment Workshop and

personnel from the Radiation Monitoring (RM) Laboratory of the I&C Workshop) can be held directly at the workplace or at the TC (Training Centre) of Kozloduy NPP.

13.8.4. The trainers and the trainees shall certify with their signatures, in an attendance form, that the training actually took place.

13.8.5. The training materials shall be submitted to Kozloduy NPP.

13.9. Required licenses, permissions, certificates, etc. of the Contractor.

The supplied equipment shall be accompanied by the necessary number of Declarations/Certificates of Compliance to confirm that the supplied equipment/spares meet the requirements specified in the factory documentation and technical specifications by identifying the non-conformances, if there are such.

14. Warranty conditions

14.1. The warranty period for the equipment shall not be less than 24 months from the commissioning date.

14.2. The warranty period for the spare equipment shall not be less than 36 months from the commissioning date.

14.3. Operating life - not less than 30 years.

14.4. Ensure the supply of spares for a period of not less than 15 years.

14.5. The equipment components shall not be produced earlier than 18 months before the date of delivery.

15. Control exercised by Kozloduy NPP EAD

KOZLODUY NPP EAD is entitled to perform audits of the Contractors' Quality system while observing the requirements of 10.ОиП.00.ИК.049, Quality procedure. Organization and auditing of Contractors/second-party audit/. The Contractors shall confirm their consent to this condition in written.

Kozloduy NPP EAD is entitled to carry out inspections and checks of the activities assigned to External Organisations (EOs). The Contractor shall provide access to personnel, premises, facilities, tools, and documents used by external organisations and their subcontractors.

16. Organisational requirements

16.1. The Contractor takes part in the initial meeting under the contract and working meetings during the implementation of this contract at Kozloduy NPP EAD.

16.2. The Contractor is liable to ensure at his own expense the presence of his own competent personnel to the initial and working meetings and technical councils held on site of Kozloduy NPP EAD who are involved in this design.

17. Additional requirements

The Contractor shall have proven experience in the area of designing, manufacturing, procurement and modernisation of fuel handling machines operated at reactor facilities with WWER-1000 reactors.

The Contractor shall provide references from the implementation of such projects in NPPs.

18. Requirements for the Contractor when assisted by subcontractors/third parties in the execution of the works

When assisted by subcontractors/third parties in the execution of the works, the Main Contractor under the contract shall:

- bear the responsibility for meeting the ToR requirements by subcontractors/third parties for the activities assigned and the quality of their work;

- define the communication channels and interactions with his subcontractors/third parties and control of the activities assigned and responsible individuals to exercise the control;

- define in an appropriate way and to the extent which is practical the required ToR requirements concerning the subcontractors/third parties under the contract depending on the activities to be implemented;

- define as a minimum the requirements for the management system (MS) of the subcontractors/third parties: - define the need for Quality Assurance Plan (QAP), applicable codes and standards, managing non-conformances, scope of documentation, tests and inspections, etc.;

- agree the QAP with the subcontractors/third parties and submit the agreed QAP to Kozloduy NPP EAD for information;

- include all aforementioned requirements in the documentation under the contract with subcontractors/third parties.

ATTACHMENTS:

Attachment 1 – Spec.Hydro-Engineering Facilities-22/09.06.2021 – Specification of the requirements for seismic resistance of fuel handling machines 5,6PL00E01.

KOZLODUY NPP EAD, Kozloduy

Hydro-Engineering Facilities and Civil Structures Department

SPECIFICATION

No. Сп.ХТС-22 of 9 June 2021

of the requirements for seismic resistance of equipment

as per order No. 22 of 8 June 2021

Re: Modernisation of fuel handling machines 5,6PL00E01

1. Scope and classification:

1.1. Scope:

This specification was drafted for the equipment described in Terms of Reference (ToR) No. 21.ЕП-2.ТЗ.785 with the following subject: "Modernisation of fuel handling machines 5,6PL00E01, type МПС-В-1000-3М-У 4.2":

Mechanical part:

- gripper assembly;
- bridge drive;
- carriage drive;
- fixed mast and turntable rotation drive;
- modified seismic supporting structures with a permanent magnet and inductive sensor;
- adjustable pull force meter for the fixed mast lifting winch;
- cable conductor (for greater angle);
- fixed mast kit (with spare parts and tools - SPT);
- telescopic mast kit (SPT);
- SPT kit.

Electrical part:

- drive motors (to ensure compatibility, use motors from one and the same manufacturer);
- additional sensors in the FHM (if needed);
- sensors for the mechanisms;
- FHM CS;
- video system.

1.2. Safety and seismic resistance classification:

Fuel handling machines are classified in the ToR and the Order as:

- safety class of the fuel handling machine – **2-Н**, as per НП-001-15 "Общие положения

обеспечения безопасности атомных станций" (General provisions for the safety of nuclear power plants);

- seismic category of the fuel handling machine – **1 (first)**, as per НП-031-01 "Нормы проектирования сейсмостойких атомных станций" (Standards for design of seismic resistant nuclear power plants).

2. Basic requirements to the equipment seismic qualification:

2.1. According to item 2.9 of НП-031-01, seismic category 1 equipment shall:

- retain its capability to perform its functions related to ensuring Plant safety during and after a safe shutdown earthquake;
- remain operable during an OBE, including after the earthquake has subsided.

2.2. Seismic resistance of the equipment and its supporting structures shall be demonstrated according to the requirements for seismic qualification of the current regulations applicable for NPPs such as:

- НП-031-01 "Нормы проектирования сейсмостойких атомных станций" (Standards for design of seismic resistant nuclear power plants);
- IEC/IEEE 60980-344 "Nuclear facilities – Equipment important to safety – Seismic qualification", 2020;
- ASME NOG-1-2015 „Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)";
- - НП-043-18 "Правила устройства и безопасной зксплуатации грузоподъемннх машин и механизмов, применяемьгх на объектах использования атомной знергии" (Rules for the design and safe operation of load-lifting machines and mechanisms used at nuclear power facilities);
- IEEE 420-2013 - Standard for the design and qualification of class 1E control boards, panels, and racks used in nuclear power generating stations;
- IEC 60034 "Rotating electrical machinery";
- ANSI/AISC N690-06 "Specification for Safety-Related Steel Structures for Nuclear Facilities";
- - ПНАЭ Г 7-002-86 "Нормы расчета на прочность оборудования и трубопроводов атомных энергетических установок" (Norms for strength calculations of equipment and pipelines on nuclear power facilities);
- ГОСТ 7516.1-90 "Общие требования в части стойкости к механическим внешним воздействующим фактором" (General requirements with respect to resistance to external mechanical effects);
- ГОСТ 30546.2 "Испытания на сейсмостойкость машин, приборов и других технических изделий (Seismic resistance tests for machines, instruments and other industrial products). General guidance and test methods";
- ГОСТ 30630 "Методы испытаний на стойкость к внешним воздействующим факторам машин, проборов и других механических изделий" (Environmental resistance test methods for machines, instruments and other industrial products);
- РД 25818-87 "Общие требования и методы испытаний на сейсмостойкость приборов и средств автоматизации, поставляемых на АЭС" (General requirements and methods of performing seismic resistance tests of instruments and automation devices supplied to NPPs);

**Note: When using the seismic load as per ГОСТ 17516, ГОСТ 30546, ГОСТ 30630 or РД 25818-87, it is necessary to prove the applicability of the load used for the place of installation of the cabinets at Kozloduy NPP according to the procedure described in item 5.3.4 of the Specification.*

2.3. The use of other regulations shall be justified.

3. Response spectra:

3.1. Attachment 1 (6 pgs.) for elevation +16,80; rooms ГА315/1 and АЭ732; RB; Units 5 and 6:

Acceleration response spectrum for elevation **+16,80** /in graphical and table form/, according to report MK-DTT-SIE-0332a "Final Response Spectra for Reactor Building", SIEMENS, 15 November 1999, App. A, pgs. 103÷105; App. B, pgs. B103÷B105.

3.2. Attachment 2 (6 pgs.) for elevation +19,34; room ГА406; RB; Units 5 and 6:

Acceleration response spectrum for node **6134** /in graphical and table form/, according to report MK-DTT-SIE-0332 "Final Response Spectra for Reactor Building", SIEMENS, 15 November 1999, App. A, pgs. 34÷36; App. B, pgs. B34÷B36.

3.3. Attachment 3 (6 pgs.) for elevation +20,40; room АЭ607/1; RB; Units 5 and 6:

Acceleration response spectrum for node **6649** /in graphical and table form/, according to report MK-DTT-SIE-0332 "Final Response Spectra for Reactor Building", SIEMENS, 15 November 1999, App. A, pgs. 31÷33; App. B, pgs. B31÷B33.

3.4. Attachment 4 (6 pgs.) for elevation +24,60; room АЭ732 and for elevation +25,70; room ГА507; RB; Units 5 and 6:

Acceleration response spectrum for node **7202** /in graphical and table form/, according to report MK-DTT-SIE-0332 "Final Response Spectra for Reactor Building", SIEMENS, 15 November 1999, App. A, pgs. 52÷54; App. B, pgs. B52÷B54.

3.5. Attachment 5 (6 pgs.) for elevation +36,90; room ГА701; RB; Units 5 and 6:

Acceleration response spectrum for node **10359** /in graphical and table form/, according to report MK-DTT-SIE-0332 "Final Response Spectra for Reactor Building", SIEMENS, 15 November 1999, App. A, pgs. 70÷72; App. B, pgs. B70÷B72.

4. Additional instructions and requirements:

4.1. Determining the seismic load:

4.1.1. The spectra applied are for SSE level (probability of occurrence 10^{-4}). The spectra values for a **DBE** (probability of occurrence 10^{-2}) are obtained as the spectra values for a **SSE** are reduced twice.

4.1.2. Directions 1 and 2 of the applied spectra are parallel to the RB structure axes and conditionally Direction 1 of the spectra is north-south while Direction 2 is east-west. Direction 3 is vertical. Consider the equipment orientation against the RB structure when determining the seismic load to be used in the seismic qualification.

4.1.3. For the Kozloduy NPP site, the maximum zero period acceleration for the response spectrum for a free ground surface for a **SSE**=0.2g and for a **DBE**=0.1g

4.1.4. The damping values can be determined in accordance with the regulation used, for example НП-031-01 "Нормы проектирования сейсмостойких атомных станций" (Standards for design of seismically resistant nuclear power plants), NRC RG 1.61 "Damping values for seismic design of nuclear power plants" or another applicable regulation.

4.1.5. If one horizontal component is needed, it should be obtained by calculating the square root of the sum of the squares of the response spectra for the two horizontal components.

4.1.6. When determining the seismic load, consider the response of the intermediate structures located between the main elevation for which the used spectra apply to or for which the seismic load and the main equipment have been calculated (for example, of an auxiliary metal structure, on a cabinet, bridge crane, etc.).

4.1.7. Should an accelerogram be used, it must have the following parameters:

- duration - 61 sec.
- intensification stage - 4 sec.
- intensive part - 17 sec.
- attenuation stage - 40 sec.

4.2. Methodology for demonstration of seismic resistance:

4.2.1. **Analytical method** – used for seismic qualification of:
Electric motors:

In this specific example, the following things have to be done:

- behaviour analysis and qualification of the electric motors and their components that sustain the effect of the seismic load, such as shafts, couplings, bearings, etc. and also considering the effects of the adjoining components like cables, etc.;
- analytical dimensional checks of structures and elements to fix separate units and devices (bolts, welds, mounting plates, and others)

NOTE: The analytical method is not recommended for complex equipment that cannot be modelled for an adequate prognosis of its response. The analysis without testing can be acceptable only if the structural integrity itself can ensure the retention of its functions.

Supports (support frames) for equipment installation (sensors, cable routes, electric motors, etc):

Seismic qualification of the supports shall be demonstrated based on analysis (strength calculations with combinations of seismic load stresses) covering:

- the structure of the supports;
- the connection of the supports to the civil structure/FHM structure
- the connection of the equipment to the supports.

4.2.2. **Experimental method** - applicable for the seismic qualification of the active equipment from item 1.1, including the FHM CS components (sensors, electric motors, mechanisms, limit switches, video system, rope pull force meter, seismic supporting structures, encoders, etc.), considering the seismic load in the place of installation as per the requirements of the documents specified in item. 2.2. It is necessary to demonstrate retention of the seismic qualification of major equipment after replacement of the components.

4.2.3. **Combination of analysis and test:**

Based on the results of the analyses performed as per item 4.2.1 and dynamic tests performed as per item 4.2.2, it is necessary to demonstrate retention of the seismic qualification status of the fuel handling machine after its modernisation.

4.2.4. **Demonstrating seismic resistance based on the results of the dynamic tests performed earlier** - demonstration of equipment seismic resistance is possible when performing seismic qualification based on the results of the following tests performed at an earlier stage:

- standard dynamic tests;
- dynamic tests of similar equipment;
- dynamic tests from other sites.

The results of the tests performed at an earlier stage shall be used as per the criteria and sequence described in item 5.3.

5. Documenting the seismic resistance qualification:

5.1. When performing a seismic qualification of the equipment **using an analysis (calculations)**, the seismic qualification document shall cover the following: regulations used; seismic qualification method; impact level; estimated response spectrum (ERS); calculation model; load combinations; evaluated parameters' thresholds; assessment criteria used; loading diagram; detailed report of the results obtained (including: natural frequencies; natural forms; diagrams of resultant loads, deformations, stresses, displacements, etc.); table with responses from the supports from the equipment fixing points; compact disc (CD) with a detailed report of the calculations made by the computer programme; summary, analysis of the obtained results and conclusions on the seismic resistance. The documents containing calculations for demonstration of strength and seismic resistance shall be submitted in full.

5.2. When performing seismic qualification **using a dynamic test**, the seismic qualification report shall clearly demonstrate that the equipment retains its functions for ensuring plant safety during and after a SSE and retains its operability during and after a DBE.

No matter whether tests for the specific equipment being delivered will be performed or results from earlier standard tests, tests for other sites or tests of similar equipment will be used, the document from the seismic qualification tests performed shall cover:

5.2.1. **Test programme and methodology** in compliance with the regulations (for example IEEE 344). This programme shall provide: information for the specific equipment being tested (including: qualification, identification, dimensions, weight, centre of gravity, installation diagram, design functions and plant safety related functions, etc.); testing method (sinusoidal load, accelerogram, etc.); type of the impact (monoaxial, biaxial or simultaneous impact along the three axes); determination of the seismic load (ERS) for the place of installation with the respective corrective factors, also considering the possible interaction between the individual axes when performing monoaxial or biaxial testing; the required functional checks before, during and after a SSE and DBE seismic load (monitoring and registration of the important parameters before and after the seismic tests, acceptance criteria, use of additional equipment and its wiring diagrams, result registration forms); exact testing sequence – measuring specific frequencies along the individual axes, impact number and level (SSE, DBE), performance tests; requirements for installation and wiring; test acceptance criteria; procedure for preparing the test documentation, etc.

5.2.2. **Test report** to prove the seismic qualification of equipment. The report shall provide:

- basis and objective of the seismic qualification tests;
- equipment classification and parameters (including diagrams if needed);
- information about the test laboratory and equipment – location, certificates, calibration certificate, etc.; description and diagram of the test bench;
- regulations stipulating the seismic tests;
- diagram for mounting the equipment on the seismic test bench (justified in the Programme and reflecting the installation in the field);
- seismic load used for the testing (justified in the Programme);
- procedure (number and sequence of the tests performed on the respective components for DBE and SSE) and seismic test instrumentation (accelerometer positioning diagram);
- seismic qualification test results – diagrams of estimated response spectrum (ERS) and test response spectrum (TRS), accelerograms of turntable and specific parts motion; relevant resonance frequencies; values (in electronic form, tables and graphs) of the following functional parameters;
- conclusions and recommendations (if needed) concerning the qualification carried out;
- photos.

5.2.3. **Seismic Performance Test Report** – this report can be an independent document or

part of a *Test Report... .* The report contains both the forms from the Programme completed with specific results (graphs, tables and digital records) of all performance tests – before, during and after the tests performed at levels of DBE and SSE and the analysis and assessment of the obtained performance results.

5.3. When performing seismic qualification of the equipment based on results from earlier standard dynamic tests/calculations for other sites or dynamic tests/calculations for similar equipment, the **Vendor/Designer shall provide an analysis and conclusion about:**

5.3.1. Relevance and feasibility of the regulations applied and conformity of the submitted document for seismic qualification with those regulations.

5.3.2. Exhaustiveness (in terms of content and scope) of the documents resulting from the performed seismic qualification tests/analyses. All the documents from the tests and/or analyses shall be submitted.

5.3.3. The similarity of the tested/analysed equipment with the specific supplied/designed for Kozloduy NPP equipment based on calculations - the physical characteristics are compared (dimensions, mass, centre of gravity, method of installation, natural frequencies, material damping, etc. influencing the equipment response to a seismic effect); equivalence of equipment functions; adequacy of the relevant operability criteria and parameters before, during and after a seismic effect.

5.3.4. The applicability of the seismic effect used during the test for the place of installation at Kozloduy NPP – the response spectra and accelerogram for the place of installation at Kozloduy NPP identified as per the above requirements (item 3, item 4.1 and item 5.2.1) are compared with the spectrum and accelerogram used during the test. The spectrum of the testing load shall cover the spectrum at the place of installation if damping is the same.

5.3.5. Adequacy of the evidence for retention of functionality (specific results of all the tests performed to demonstrate the equipment functionality during and after a seismic effect as well as an analysis and assessment of the obtained functionality results) and integrity during and after a seismic effect. The evidence shall not be informative or declarative only.

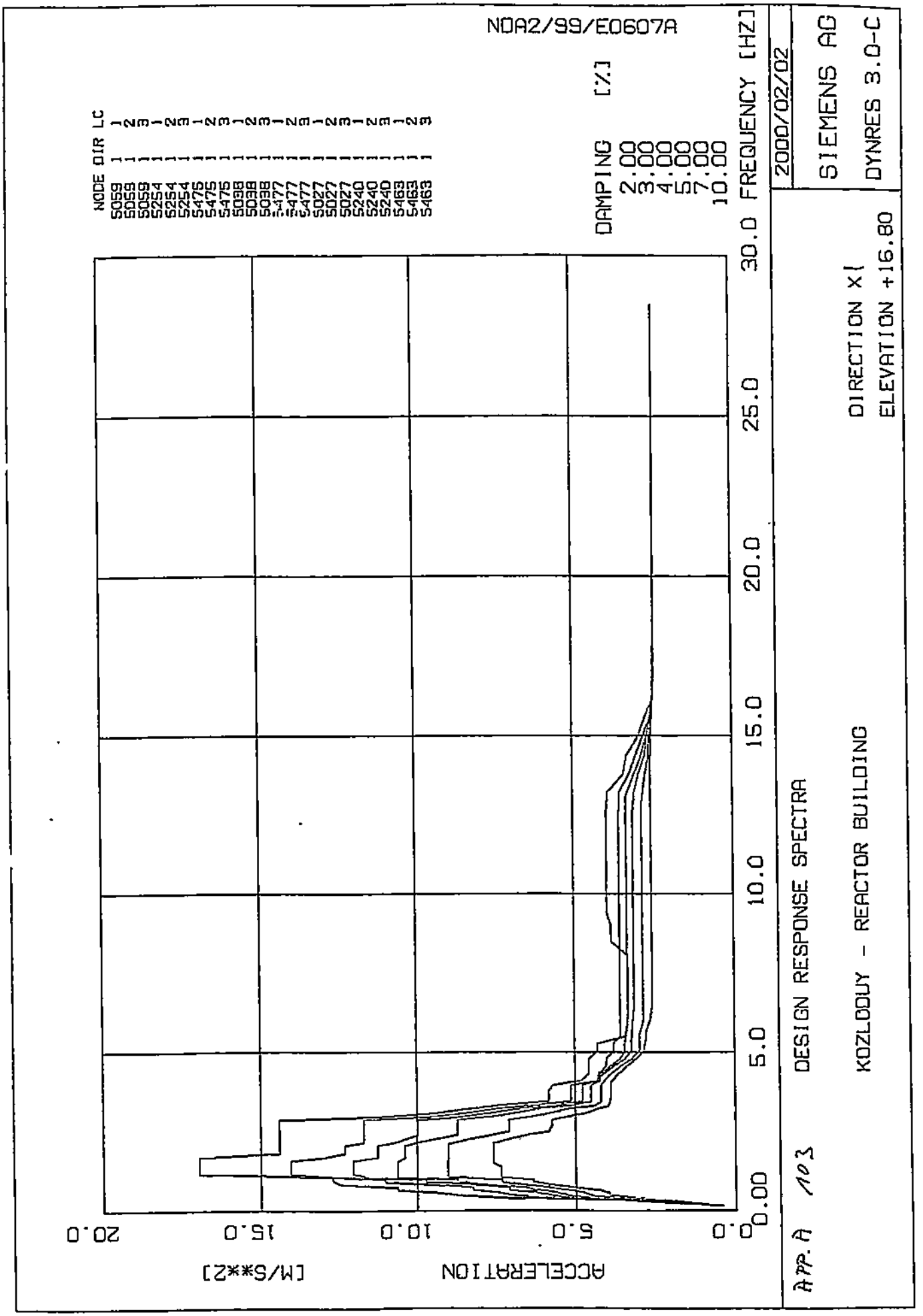
6. Submitting the documentation to the Contracting Authority

6.1. When performing a dynamic test for the purposes of the specific design as per item 4.9 of Quality Procedure 30.ОУ.ОК.ИК.27, 'Classification of SSCs. Graded quality assurance requirements' – "The specification (*programme and methodology*) shall be drafted by the organisation responsible for the conduct of the test and sent to be reviewed and approved by the HEF and CS Department not later than one month before the test".

6.2. According to the requirements defined in item 4.9 of Quality Procedure 30.ОУ.ОК.ИК.27, 'Classification of SSCs. Graded quality assurance requirements', the seismic qualification documentation shall be sent to be reviewed and approved by the HEF and CS Department for review and acceptance of the results. The seismic qualification documents shall be submitted not later than two months before the delivery to ensure enough time for review and possible revision of the documents (correction of nonconformances) before the actual equipment delivery.

7. Abbreviations used:

SPT – spare parts;
SSE – safe shutdown earthquake;
DBE/OBE – design basis earthquake / operating basis earthquake;
FHM – fuel handling machine;
RB – reactor building;
FHM CS – fuel handling machine control system;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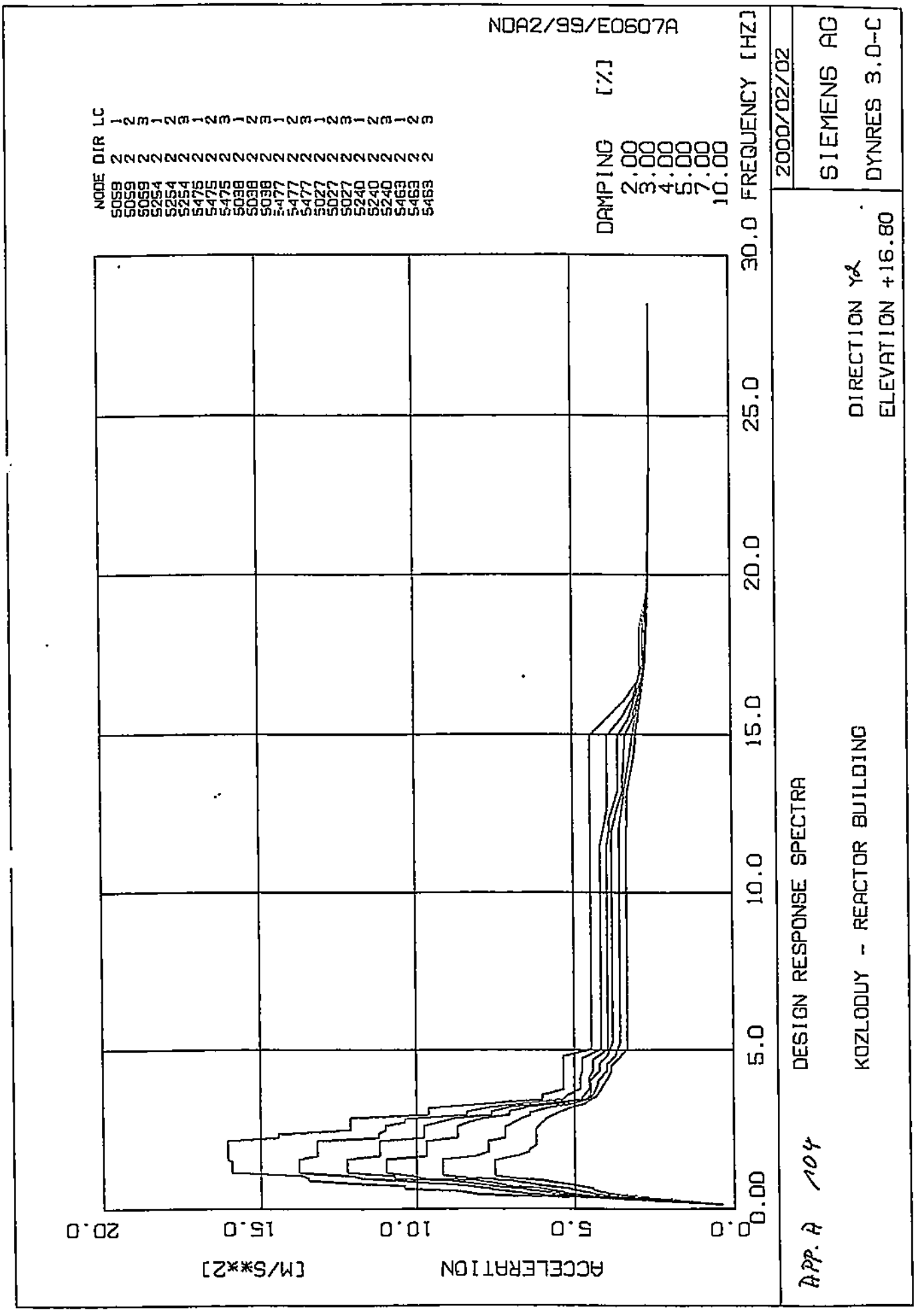
KOZLODUY - REACTOR BUILDING
DESIGN RESPONSE SPECTRA
APP. A 103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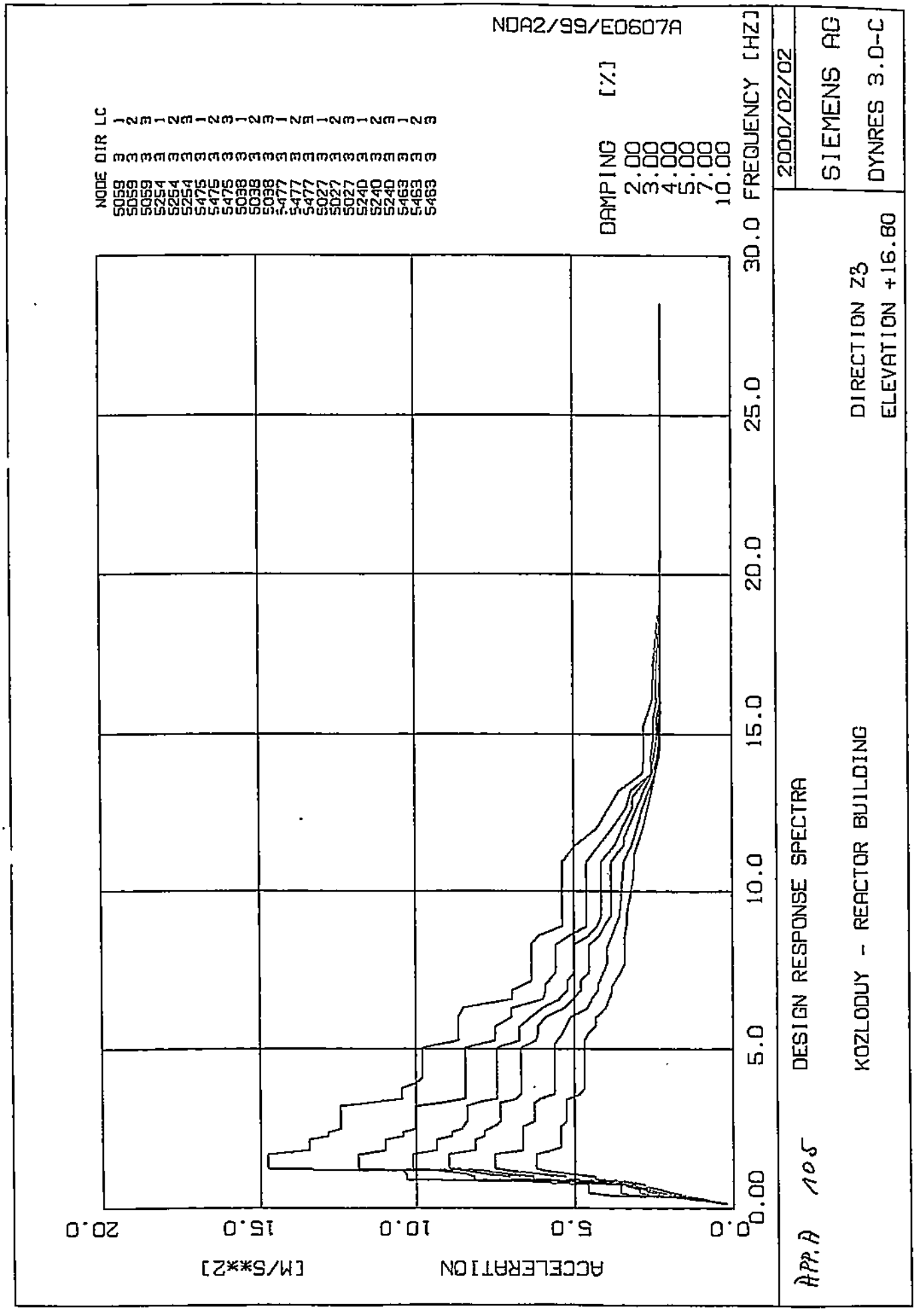
2000/02/02
SIEMENS AG
DYNRES 3.0-C
DIRECTION Y
ELEVATION +16.80
KOZLODUY - REACTOR BUILDING
DESIGN RESPONSE SPECTRA
APP. A 104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ACCELERATION
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DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
DIRECTION Z3
ELEVATION +16.80
2000/02/02
SIEMENS AG
DYNRES 3.0-C
APP.A 105

DESIGN RESPONSE SPECTRA

KOZLODUY - REACTOR BUILDING

DIRECTION X
ELEVATION +16.80

D= 2.00 %		D= 3.00 %		D= 4.00 %		D= 5.00 %		D= 7.00 %		D=10.00 %	
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0.26	2.27	0.26	2.03	0.26	1.82	0.26	1.65	0.26	1.38	0.26	1.17
0.34	3.51	0.34	3.05	0.34	2.69	0.34	2.42	0.34	2.09	0.34	1.87
0.43	7.19	0.43	5.87	0.43	4.95	0.43	4.30	0.43	3.49	0.43	2.89
0.51	8.59	0.51	6.86	0.51	5.76	0.51	5.15	0.51	4.45	0.53	3.97
0.60	9.41	0.60	7.43	0.60	6.26	0.60	5.62	0.60	4.75	0.60	3.97
0.68	10.63	0.68	8.24	0.68	7.12	0.68	6.33	0.68	5.22	0.68	4.22
0.77	10.63	0.77	8.24	0.77	7.12	0.77	6.55	0.77	5.83	0.77	4.99
0.85	12.39	0.85	9.72	0.85	8.51	0.85	7.83	0.85	6.74	0.85	5.88
0.99	12.68	0.95	11.03	0.95	9.73	0.94	8.75	0.94	7.35	0.94	6.36
1.11	12.68	1.02	11.03	1.02	9.73	1.02	8.75	1.02	7.35	1.02	6.36
1.20	16.97	1.11	12.33	1.11	11.56	1.11	10.64	1.11	9.05	1.11	7.36
1.73	16.97	1.19	14.04	1.19	12.02	1.58	10.64	1.58	9.05	1.45	7.36
1.84	14.39	1.61	14.04	1.61	12.02	1.73	10.39	1.73	9.03	1.53	7.59
2.88	14.39	1.73	13.01	1.73	11.25	2.07	10.39	2.14	9.03	2.15	7.59
2.99	11.10	1.84	12.29	2.07	11.25	2.19	10.02	2.30	8.33	2.30	7.10
3.11	9.54	2.07	12.29	2.19	10.71	2.30	9.41	2.42	7.63	2.42	6.52
3.34	7.47	2.19	11.70	2.42	9.98	2.42	8.75	2.53	7.11	2.53	5.82
3.45	5.84	2.88	11.70	2.88	9.98	2.88	8.75	2.88	7.11	2.76	5.72
3.79	5.84	2.99	9.59	2.99	8.52	2.99	7.65	2.99	6.38	2.87	5.72
3.97	5.71	3.11	8.46	3.22	6.76	3.11	6.90	3.11	5.80	2.99	5.23
4.14	4.78	3.22	7.52	3.34	5.60	3.22	6.13	3.22	5.21	3.11	4.71
4.37	4.56	3.34	6.34	3.45	4.77	3.34	5.07	3.34	4.41	3.22	4.35
4.77	4.56	3.45	5.13	3.97	4.77	3.45	4.53	3.45	4.19	3.34	3.97
5.06	4.32	3.97	5.13	4.14	4.30	3.97	4.53	3.97	4.19	3.62	3.88
5.29	4.32	4.14	4.31	4.28	4.30	4.14	4.24	4.14	4.06	4.04	3.88
5.52	3.42	4.37	4.29	4.60	3.90	4.25	4.24	4.37	3.87	4.37	3.63
5.97	3.37	4.60	4.01	4.83	3.59	4.60	3.78	4.60	3.58	4.60	3.38
6.32	3.32	4.79	4.01	5.06	3.46	4.83	3.42	4.83	3.19	4.83	3.08
8.07	3.32	5.06	3.80	5.29	3.46	5.06	3.23	5.06	2.99	5.06	2.85
8.50	3.84	5.29	3.80	6.04	3.33	5.44	3.23	5.58	2.99	5.52	2.77
8.92	3.84	5.52	3.57	13.10	3.33	6.61	3.14	6.04	2.85	5.66	2.77
9.35	3.97	12.65	3.57	13.80	3.08	12.65	3.14	12.95	2.85	6.04	2.65
12.65	3.97	13.22	3.55	14.37	2.87	13.22	3.09	13.80	2.76	6.61	2.58
13.22	3.92	13.80	3.23	15.52	2.58	13.80	2.96	14.37	2.63	12.65	2.58
13.80	3.42	14.37	3.04	16.25	2.51	14.37	2.75	14.74	2.63	13.80	2.56
14.37	3.33	15.52	2.61	17.25	2.48	16.42	2.50	15.52	2.55	14.37	2.56
14.95	2.96	16.13	2.51	28.50	2.44	17.25	2.48	16.67	2.48	14.95	2.55
15.52	2.75	17.25	2.48			28.50	2.44	20.70	2.44	16.69	2.48
16.10	2.52	28.50	2.44					28.50	2.43	28.50	2.44
19.55	2.46										
28.50	2.44										

DESIGN RESPONSE SPECTRA

KOZLODUY - REACTOR BUILDING

DIRECTION Y
ELEVATION +16.80

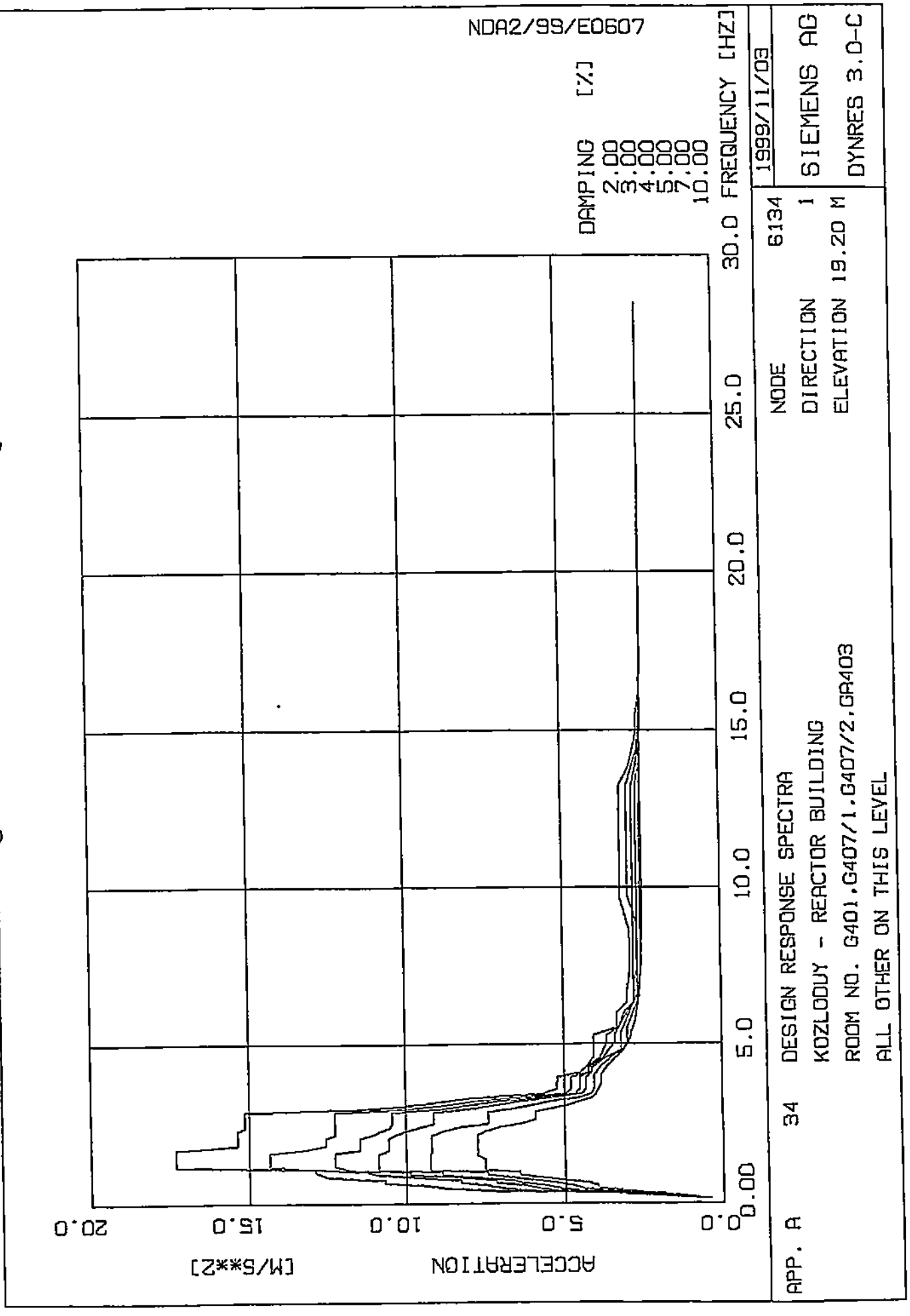
D= 2.00 %		D= 3.00 %		D= 4.00 %		D= 5.00 %		D= 7.00 %		D=10.00 %	
FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL
0.17	0.42	0.17	0.41	0.17	0.41	0.17	0.40	0.17	0.39	0.17	0.39
0.34	4.08	0.26	2.00	0.26	1.84	0.26	1.71	0.26	1.51	0.26	1.32
0.43	6.40	0.34	3.25	0.34	2.76	0.34	2.52	0.34	2.21	0.34	1.95
0.51	8.14	0.43	5.24	0.43	4.70	0.43	4.27	0.43	3.64	0.43	3.06
0.60	8.77	0.51	6.52	0.51	5.54	0.51	5.06	0.51	4.42	0.51	3.85
0.68	10.40	0.60	7.24	0.60	6.36	0.60	5.73	0.60	4.92	0.64	4.44
0.77	10.40	0.77	8.42	0.68	6.77	0.68	6.10	0.68	5.22	0.68	4.44
0.85	12.24	0.85	9.68	0.77	7.66	0.77	7.04	0.77	6.03	0.77	4.90
0.94	13.47	0.94	10.60	0.85	8.46	0.85	7.65	0.85	6.58	0.85	5.56
1.02	13.47	1.02	11.79	0.94	9.17	0.94	8.16	0.94	6.97	0.94	5.99
1.11	13.63	1.11	12.02	1.02	10.70	1.02	9.78	1.02	8.43	1.02	6.91
1.19	15.90	1.19	13.77	1.11	10.70	1.11	10.13	1.13	9.17	1.11	7.53
1.53	15.90	1.61	13.77	1.19	12.21	1.19	10.98	1.61	9.17	1.58	7.53
1.62	16.01	1.73	13.18	1.61	12.21	1.61	10.98	1.73	8.11	1.73	6.86
2.19	16.01	2.19	13.18	1.73	11.17	1.73	9.69	1.84	7.73	1.84	6.45
2.30	14.41	2.30	11.21	2.19	11.17	2.19	9.69	2.19	7.73	1.96	6.42
2.40	14.41	2.42	11.21	2.30	9.77	2.30	8.71	2.30	7.18	2.07	6.23
2.53	12.11	2.53	10.98	2.65	9.77	2.65	8.71	2.64	7.18	2.58	6.23
2.88	12.11	2.65	10.98	2.76	9.32	2.76	8.37	2.88	6.70	2.76	6.03
2.99	9.63	2.76	10.37	2.88	8.79	2.88	7.92	2.99	6.41	2.88	5.89
3.19	9.63	2.86	10.37	2.99	7.62	2.99	7.05	3.07	6.41	2.99	5.69
3.34	7.83	2.99	8.39	3.11	7.62	3.11	7.05	3.22	5.72	3.11	5.45
3.45	6.03	3.11	8.39	3.22	7.00	3.22	6.46	3.34	5.00	3.22	5.07
3.62	6.03	3.22	7.68	3.34	5.89	3.34	5.47	3.45	4.62	3.34	4.69
3.79	5.34	3.34	6.60	3.45	4.78	3.45	4.64	3.62	4.41	3.62	4.28
4.83	5.34	3.45	5.33	3.48	4.78	3.62	4.50	3.79	4.34	4.14	3.95
5.06	4.45	3.62	5.21	3.79	4.55	4.07	4.50	3.97	4.25	4.37	3.84
14.95	4.45	3.79	4.81	4.14	4.55	4.37	4.20	4.02	4.25	4.50	3.84
16.10	3.32	4.14	4.81	4.37	4.41	4.60	4.20	4.37	3.96	4.83	3.54
16.67	2.94	4.37	4.74	4.73	4.41	4.83	3.97	4.60	3.96	5.06	3.33
17.25	2.85	4.79	4.74	5.06	3.95	5.29	3.80	4.83	3.72	12.05	3.33
18.40	2.85	5.06	4.14	11.50	3.95	11.92	3.80	5.29	3.56	12.65	3.28
19.55	2.66	11.50	4.14	12.07	3.87	12.65	3.60	12.04	3.56	13.17	3.28
23.11	2.57	12.65	3.91	12.29	3.87	13.22	3.42	13.80	3.30	14.37	3.07
28.50	2.53	14.95	3.91	13.22	3.57	13.74	3.42	14.95	3.12	14.95	3.01
		15.52	3.45	14.95	3.57	14.95	3.34	17.25	2.72	15.00	3.01
		16.10	3.08	15.52	3.21	15.52	3.06	19.55	2.62	17.25	2.71
		17.25	2.77	16.67	2.84	15.69	3.06	23.11	2.55	19.55	2.60
		18.40	2.77	17.25	2.74	16.67	2.81	28.50	2.53	23.11	2.55
		19.55	2.65	18.17	2.74	17.25	2.73			28.50	2.52
		23.11	2.56	19.55	2.65	17.64	2.73				
		28.50	2.53	23.11	2.56	19.55	2.64				
				28.50	2.53	23.11	2.56				
						28.50	2.53				

DESIGN RESPONSE SPECTRA

KOZLODUY - REACTOR BUILDING

DIRECTION Z
ELEVATION +16.80

D= 2.00 %		D= 3.00 %		D= 4.00 %		D= 5.00 %		D= 7.00 %		D=10.00 %	
FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL
0.17	0.26	0.17	0.25	0.17	0.24	0.17	0.24	0.17	0.23	0.17	0.23
0.26	1.07	0.26	0.98	0.26	0.90	0.26	0.84	0.26	0.74	0.26	0.64
0.34	1.66	0.34	1.49	0.34	1.35	0.34	1.25	0.34	1.10	0.34	0.98
0.43	3.67	0.43	2.98	0.43	2.55	0.43	2.23	0.43	1.83	0.43	1.53
0.51	4.58	0.51	3.59	0.51	2.98	0.55	2.78	0.51	2.28	0.51	1.96
0.77	4.58	0.77	3.59	0.60	2.98	0.60	2.78	0.73	3.11	0.60	2.32
0.85	6.96	0.85	5.58	0.72	3.40	0.68	3.11	0.77	3.11	0.71	2.82
0.94	10.33	0.94	8.19	0.77	3.40	0.77	3.31	0.85	3.99	0.77	2.82
1.11	10.33	1.02	8.19	0.85	5.01	0.85	4.61	0.94	5.32	0.85	3.37
1.19	10.43	1.11	8.41	0.94	7.05	0.94	6.32	1.02	5.32	0.94	4.39
1.28	14.75	1.19	9.31	1.02	7.05	1.02	6.32	1.11	6.14	1.02	4.39
1.73	14.75	1.28	11.84	1.11	7.73	1.11	7.12	1.19	7.02	1.11	5.19
1.84	13.44	1.73	11.84	1.19	8.53	1.19	7.87	1.28	7.52	1.19	5.96
2.19	13.44	1.84	11.00	1.28	10.11	1.28	8.96	1.73	7.52	1.28	6.22
2.30	12.81	2.19	11.00	1.73	10.11	1.73	8.96	1.84	6.64	1.73	6.22
2.42	12.81	2.30	10.42	1.84	9.37	1.84	8.15	2.59	6.64	1.84	5.72
2.53	12.42	2.42	10.42	2.19	9.37	2.19	8.15	2.76	6.28	1.96	5.45
3.22	12.42	2.53	10.04	2.30	8.88	2.30	7.85	3.34	6.28	2.60	5.45
3.34	11.53	3.22	10.04	2.42	8.88	2.45	7.85	3.45	6.09	2.76	5.26
3.45	10.45	3.34	9.17	2.53	8.56	2.65	7.45	3.62	5.63	3.42	5.26
3.79	10.45	3.45	8.47	2.76	8.41	2.76	7.34	5.18	5.63	3.62	4.83
3.97	9.97	5.06	8.47	3.22	8.41	3.34	7.34	5.52	5.36	3.79	4.70
4.14	9.80	5.29	7.49	3.34	8.10	3.45	6.83	6.04	5.12	5.29	4.70
5.06	9.80	5.75	7.49	3.45	7.45	3.62	6.69	6.32	4.60	5.52	4.56
5.29	8.67	6.04	6.98	5.06	7.45	5.06	6.69	6.61	4.46	5.75	4.35
6.04	8.67	6.32	6.98	5.29	6.75	5.29	6.22	6.90	4.26	6.04	4.33
6.32	8.52	6.61	5.98	5.75	6.75	5.52	6.16	7.08	4.26	6.32	4.02
6.61	6.94	6.90	5.91	6.04	6.38	5.75	6.16	7.76	3.96	6.61	3.91
6.90	6.94	7.06	5.91	6.32	6.01	6.04	5.89	8.23	3.96	6.90	3.81
7.19	6.39	7.47	5.58	6.61	5.47	6.32	5.35	8.63	3.82	7.03	3.81
7.47	6.36	8.34	5.58	6.90	5.21	6.61	5.04	8.91	3.70	7.47	3.56
8.34	6.36	8.63	5.15	7.19	5.21	6.90	4.80	9.20	3.57	7.76	3.41
8.63	6.10	8.91	4.62	7.47	5.00	7.19	4.80	9.40	3.57	8.63	3.41
8.91	5.38	10.92	4.62	8.34	5.00	7.47	4.55	10.91	3.45	8.91	3.37
10.92	5.38	12.07	3.76	8.63	4.55	8.34	4.55	11.50	3.18	9.20	3.35
11.50	4.93	12.65	3.38	8.91	4.27	8.63	4.21	12.65	2.84	9.35	3.35
12.07	4.25	13.22	3.23	9.20	4.15	8.91	4.04	13.22	2.64	10.35	3.17
13.22	3.59	13.80	2.58	10.92	4.15	9.20	3.84	13.80	2.43	10.92	3.11
13.80	2.85	14.31	2.58	11.50	3.70	10.92	3.84	14.95	2.32	11.18	3.11
14.37	2.79	14.95	2.49	12.07	3.48	11.50	3.42	16.10	2.28	12.07	2.82
15.27	2.79	15.52	2.49	12.65	3.16	11.74	3.42	28.50	2.24	13.22	2.57
16.10	2.52	16.10	2.38	12.99	3.16	13.22	2.80			14.37	2.32
16.67	2.52	16.67	2.38	13.80	2.56	13.80	2.52			14.48	2.32
17.25	2.49	17.25	2.38	14.95	2.39	14.37	2.35			16.67	2.25
19.55	2.26	19.55	2.26	15.52	2.39	15.36	2.33			20.48	2.25
21.09	2.26	22.35	2.26	16.10	2.32	16.10	2.30			28.50	2.24
28.50	2.24	28.50	2.24	17.25	2.32	16.57	2.30				
				19.55	2.25	28.50	2.25				
				22.83	2.25						
				28.50	2.24						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4.000
5.000
10.00
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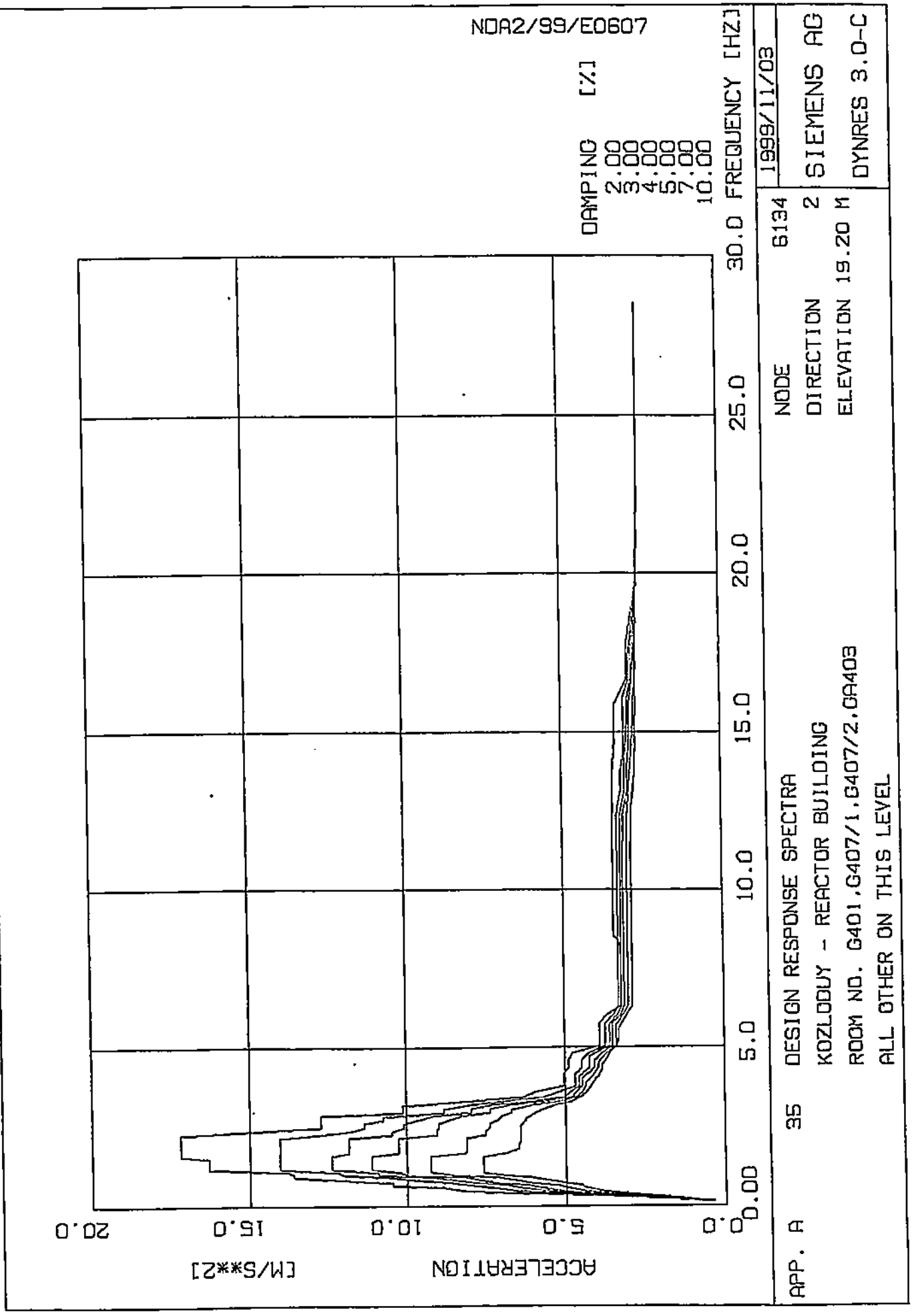
20.0
15.0
10.0
5.0
0.00
0.0
5.0
10.0
15.0
20.0
ACCELERATION
[M/S**2]
1999/11/03
SIEMENS AG
DYNRES 3.0-C
NODE 6134
DIRECTION 1
ELEVATION 19.20 M
APP. A
34 DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. G401,G407/1,G407/2,GA03
ALL OTHER ON THIS LEVEL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4.00
5.00
7.00
10.00
ACCELERATION [M/S**2]
FREQUENCY [HZ]
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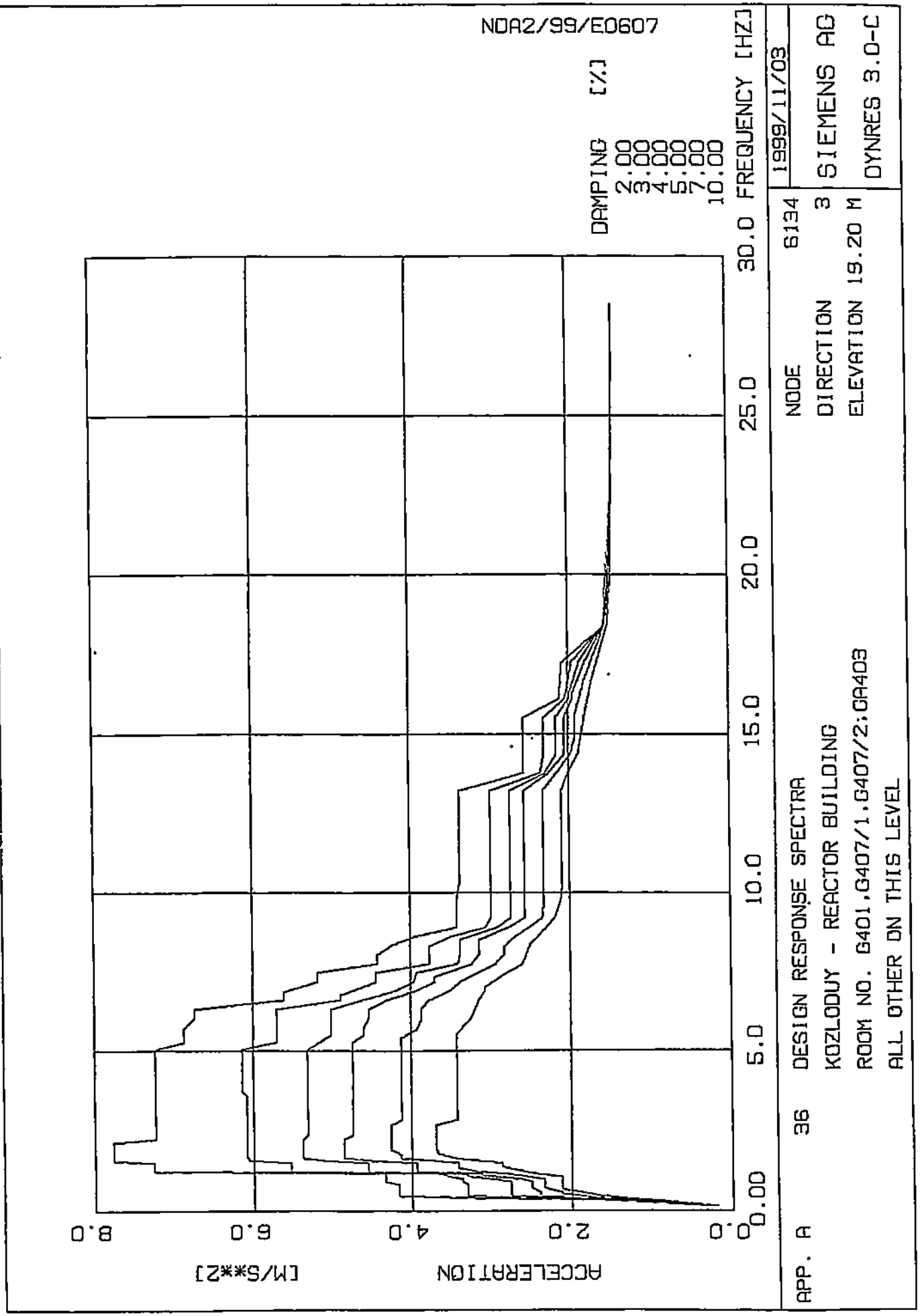
10.0
15.0
20.0
25.0
30.0
0.00
1999/11/03
SIEMENS AG
DYNRES 3.0-C
APP. A
35 DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. G401,G407/1,G407/2,GA403
ALL OTHER ON THIS LEVEL
NODE 6134
DIRECTION 2
ELEVATION 19.20 M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DAMPING [%]
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3.000
4.000
5.000
7.000
10.00
ACCELERATION [M/S**2]
FREQUENCY [HZ]
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2.0
4.0
6.0
8.0
0.00
5.0
10.0
15.0
20.0
25.0
30.0
APP. A
36 DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. G401,G407/1,G407/2;GA403
ALL OTHER ON THIS LEVEL
NODE 6134
DIRECTION 3
ELEVATION 19.20 M
1999/11/03
SIEMENS AG
DYNRES 3.0-C

DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. G401,G407/1,G407/2,GA403
ALL OTHER ON THIS LEVEL

NODE 6134
DIRECTION 1
ELEVATION 19.20 M

D= 2.00 %		D= 3.00 %		D= 4.00 %		D= 5.00 %		D= 7.00 %		D=10.00 %	
FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL
0.17	0.45	0.17	0.43	0.17	0.42	0.17	0.41	0.17	0.41	0.17	0.44
0.26	2.28	0.26	2.03	0.26	1.82	0.26	1.65	0.26	1.38	0.26	1.17
0.34	3.51	0.34	3.05	0.34	2.70	0.34	2.42	0.34	2.09	0.34	1.88
0.43	7.21	0.43	5.88	0.43	4.97	0.43	4.31	0.43	3.51	0.43	2.90
0.51	8.62	0.51	6.89	0.51	5.79	0.51	5.17	0.51	4.47	0.53	3.99
0.60	9.46	0.60	7.48	0.60	6.30	0.60	5.65	0.60	4.78	0.60	3.99
0.68	10.69	0.68	8.28	0.68	7.17	0.68	6.37	0.68	5.26	0.68	4.25
0.77	10.69	0.77	8.28	0.77	7.17	0.77	6.60	0.77	5.88	0.85	5.91
0.85	12.50	0.85	9.81	0.85	8.59	0.85	7.90	0.85	6.81	0.94	6.41
1.02	12.90	0.94	10.89	0.95	9.88	0.95	8.88	0.94	7.42	1.02	6.41
1.11	12.90	1.02	11.22	1.02	9.88	1.02	8.88	1.02	7.42	1.11	7.48
1.20	17.29	1.11	12.59	1.11	11.80	1.11	10.87	1.11	9.22	1.45	7.48
1.73	17.29	1.19	14.34	1.19	12.27	1.58	10.87	1.58	9.22	1.53	7.73
1.84	15.34	1.61	14.34	1.61	12.27	1.73	10.57	1.73	9.21	2.19	7.73
2.30	15.34	1.73	13.26	1.73	11.47	2.07	10.57	2.16	9.21	2.30	7.51
2.42	15.13	1.84	12.54	2.07	11.47	2.19	10.36	2.30	8.86	2.42	7.04
2.88	15.13	2.07	12.54	2.19	11.07	2.30	10.05	2.42	8.28	2.53	6.38
2.99	11.59	2.19	12.28	2.30	10.83	2.42	9.56	2.53	7.40	2.65	5.92
3.11	9.99	2.88	12.28	2.42	10.51	2.53	9.14	2.88	7.40	2.87	5.92
3.34	7.98	2.99	10.03	2.53	10.44	2.88	9.14	2.99	6.64	2.99	5.43
3.45	5.69	3.11	8.86	2.88	10.44	2.99	7.97	3.11	6.05	3.11	4.89
3.62	5.23	3.22	7.92	2.99	8.90	3.11	7.22	3.22	5.44	3.22	4.52
3.79	5.23	3.34	6.73	3.22	7.08	3.22	6.40	3.34	4.59	3.34	4.16
3.97	5.21	3.45	4.99	3.34	5.92	3.34	5.36	3.45	4.14	3.45	4.02
4.14	4.46	3.62	4.79	3.45	4.64	3.45	4.44	3.62	4.08	3.79	3.85
4.37	4.24	3.97	4.79	3.62	4.52	3.62	4.33	4.03	4.08	4.04	3.85
4.60	4.06	4.14	4.24	3.97	4.52	3.97	4.33	4.37	3.81	4.37	3.61
5.29	4.06	4.33	4.24	4.14	4.22	4.14	4.15	4.60	3.52	4.60	3.38
5.52	3.32	4.60	3.86	4.27	4.22	4.25	4.15	4.83	3.13	4.83	3.11
6.00	3.32	5.06	3.66	4.60	3.77	4.60	3.67	5.06	2.97	5.06	2.95
6.32	2.98	5.29	3.66	5.06	3.39	4.83	3.20	5.56	2.97	5.75	2.75
6.72	2.98	5.52	3.28	5.29	3.39	5.06	3.20	6.32	2.68	6.04	2.70
7.47	2.87	6.04	3.06	6.04	2.95	5.38	3.20	6.90	2.60	6.07	2.70
8.50	2.87	6.32	2.79	6.32	2.77	6.61	2.65	7.19	2.60	6.61	2.59
9.57	3.17	6.61	2.79	13.22	2.77	13.22	2.65	8.05	2.54	6.89	2.59
13.22	3.17	6.90	2.74	13.80	2.64	13.80	2.56	12.65	2.54	7.47	2.54
13.80	2.85	7.06	2.74	14.66	2.56	14.14	2.56	13.22	2.52	9.20	2.50
14.37	2.73	7.47	2.66	15.52	2.52	15.52	2.49	14.37	2.52	14.37	2.50
14.95	2.59	8.50	2.66	16.43	2.49	16.43	2.49	14.95	2.50	14.98	2.49
15.49	2.59	8.92	2.71	18.89	2.45	18.61	2.45	16.76	2.48	15.15	2.49
16.10	2.52	9.68	2.93	28.50	2.43	28.50	2.43	28.50	2.44	28.50	2.44
17.25	2.47	13.22	2.93								
28.50	2.44	14.37	2.59								
		15.52	2.53								
		16.10	2.50								
		16.28	2.50								
		19.39	2.45								
		28.50	2.43								

DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. G401,G407/1,G407/2,GA403
ALL OTHER ON THIS LEVEL

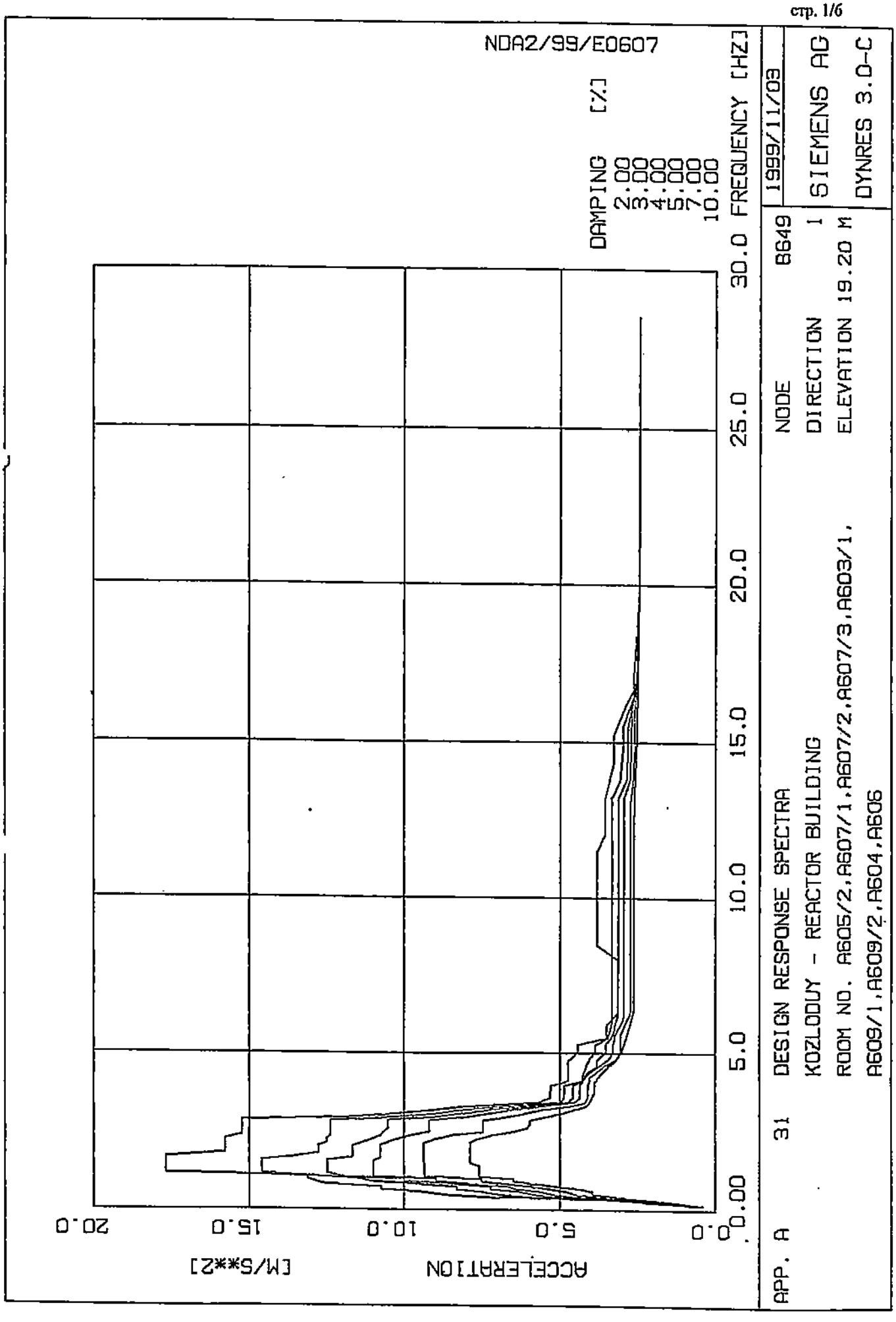
NODE 6134
DIRECTION 2
ELEVATION 19.20 M

D= 2.00 %		D= 3.00 %		D= 4.00 %		D= 5.00 %		D= 7.00 %		D=10.00 %	
FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL
0.17	0.42	0.17	0.42	0.17	0.41	0.17	0.40	0.17	0.40	0.17	0.39
0.34	4.08	0.26	2.01	0.26	1.85	0.26	1.72	0.26	1.52	0.26	1.32
0.43	6.41	0.34	3.26	0.34	2.77	0.34	2.52	0.34	2.21	0.34	1.95
0.51	8.20	0.43	5.26	0.43	4.71	0.43	4.28	0.43	3.65	0.43	3.07
0.60	8.82	0.51	6.57	0.51	5.57	0.51	5.09	0.51	4.46	0.51	3.89
0.68	10.49	0.60	7.30	0.60	6.41	0.60	5.78	0.60	4.96	0.64	4.48
0.77	10.49	0.77	8.55	0.68	6.86	0.68	6.16	0.68	5.27	0.68	4.48
0.85	12.33	0.85	9.83	0.77	7.79	0.77	7.15	0.77	6.13	0.77	4.98
0.94	13.61	0.94	10.61	0.85	8.60	0.85	7.78	0.85	6.70	0.85	5.66
1.02	13.61	1.02	12.03	0.94	9.17	0.94	8.16	0.94	7.11	0.94	6.10
1.11	13.77	1.11	12.15	1.02	10.92	1.02	9.98	1.02	8.52	1.02	7.00
1.19	16.28	1.19	14.05	1.11	10.92	1.11	10.19	1.13	9.26	1.11	7.59
1.53	16.28	1.53	14.05	1.19	12.40	1.19	11.12	1.61	9.26	1.58	7.59
1.62	17.17	1.62	14.06	1.61	12.40	1.61	11.12	1.73	8.13	1.73	6.88
2.29	17.17	2.19	14.06	1.73	11.86	1.73	10.26	1.84	8.11	1.84	6.48
2.42	14.57	2.30	12.75	2.19	11.86	2.19	10.26	2.19	8.11	1.95	6.48
2.53	12.72	2.42	11.72	2.30	10.48	2.30	9.05	2.30	7.52	2.07	6.42
2.88	12.72	2.53	11.35	2.39	10.48	2.42	9.05	2.42	7.52	2.53	6.42
2.99	10.15	2.65	11.35	2.53	10.09	2.53	8.99	2.53	7.39	2.65	6.36
3.20	10.15	2.76	10.75	2.65	10.09	2.65	8.99	2.65	7.38	2.76	6.25
3.34	8.30	2.86	10.75	2.76	9.65	2.76	8.66	2.76	7.13	2.81	6.25
3.45	6.34	2.99	8.82	2.88	9.21	2.88	8.29	2.88	7.01	2.99	5.94
3.62	5.97	3.11	8.82	2.99	7.97	2.99	7.37	2.99	6.70	3.11	5.68
3.79	5.05	3.22	8.03	3.11	7.97	3.11	7.37	3.07	6.70	3.22	5.28
4.14	5.05	3.34	6.94	3.22	7.31	3.22	6.74	3.22	5.98	3.34	4.80
4.37	4.90	3.45	5.65	3.34	6.14	3.34	5.66	3.34	5.13	3.45	4.55
4.60	4.90	3.62	5.23	3.45	5.04	3.45	4.76	3.45	4.67	3.62	4.34
4.83	4.76	3.79	4.69	3.62	4.85	3.62	4.63	3.62	4.46	3.97	4.08
5.06	3.93	4.14	4.69	3.79	4.55	3.79	4.49	3.79	4.36	4.14	3.93
5.75	3.93	4.37	4.48	4.10	4.55	4.02	4.49	3.86	4.36	4.37	3.85
6.04	3.65	4.60	4.48	4.37	4.25	4.37	4.10	4.14	4.12	4.45	3.85
6.32	3.21	4.83	4.26	4.73	4.25	4.60	4.10	4.37	3.96	4.83	3.57
8.07	3.21	5.06	3.73	5.06	3.59	4.83	3.85	4.54	3.96	5.06	3.38
8.33	3.28	5.75	3.73	5.75	3.59	5.06	3.49	4.83	3.68	5.29	3.30
8.50	3.42	6.04	3.46	6.04	3.32	5.75	3.49	5.06	3.37	5.61	3.30
12.40	3.42	6.32	3.28	6.32	3.19	6.04	3.23	5.71	3.37	6.04	3.04
13.22	3.39	12.38	3.28	12.34	3.19	6.32	3.11	6.04	3.13	6.32	2.86
13.80	3.39	13.22	3.14	13.22	3.01	11.50	3.11	6.32	2.98	6.61	2.85
14.95	3.32	13.80	3.14	14.30	3.01	12.41	3.09	12.06	2.98	11.50	2.85
15.88	3.32	14.37	3.03	15.52	2.92	13.22	2.93	14.52	2.80	12.07	2.83
16.67	2.91	16.10	3.03	16.10	2.92	13.98	2.92	15.52	2.73	12.65	2.82
17.87	2.91	16.67	2.86	16.67	2.81	14.95	2.85	16.10	2.73	12.67	2.82
19.55	2.63	17.46	2.86	17.25	2.77	15.99	2.85	16.67	2.68	13.80	2.71
23.11	2.54	19.55	2.62	17.67	2.77	16.67	2.76	17.72	2.67	14.36	2.71
28.50	2.53	23.11	2.54	19.55	2.62	17.25	2.73	23.11	2.53	15.52	2.66
		28.50	2.52	23.11	2.53	17.52	2.73	28.50	2.52	18.38	2.62
				28.50	2.52	19.55	2.62			23.11	2.53
						23.11	2.53			28.50	2.52
						28.50	2.52				

DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. G401,G407/1,G407/2,GA403
ALL OTHER ON THIS LEVEL

NODE 6134
DIRECTION 3
ELEVATION 19.20 M

D= 2.00 %		D= 3.00 %		D= 4.00 %		D= 5.00 %		D= 7.00 %		D=10.00 %	
FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL
0.17	0.23	0.17	0.22	0.17	0.21	0.17	0.21	0.17	0.19	0.17	0.20
0.26	1.02	0.26	0.93	0.26	0.85	0.26	0.79	0.26	0.69	0.26	0.59
0.34	1.61	0.34	1.43	0.34	1.28	0.34	1.17	0.34	0.99	0.34	0.87
0.43	3.24	0.43	2.66	0.43	2.25	0.43	1.96	0.43	1.61	0.43	1.32
0.51	4.17	0.51	3.31	0.51	2.76	0.51	2.39	0.54	2.13	0.51	1.66
0.85	4.17	0.85	3.31	0.85	2.76	0.60	2.39	0.60	2.13	0.60	1.88
0.94	4.33	0.94	3.37	0.94	2.78	0.77	2.50	0.68	2.26	0.70	2.12
1.19	4.33	1.02	3.37	1.02	2.94	0.94	2.50	0.77	2.34	1.11	2.12
1.28	7.26	1.11	3.53	1.11	3.26	1.02	2.62	1.02	2.34	1.19	2.44
1.53	7.26	1.19	3.63	1.19	3.35	1.14	3.13	1.11	2.57	1.28	2.62
1.62	7.77	1.28	5.52	1.28	4.55	1.19	3.13	1.19	2.81	1.36	2.77
2.19	7.77	1.53	5.52	1.53	4.55	1.28	3.94	1.28	3.21	1.45	2.87
2.30	7.24	1.62	6.06	1.62	5.12	1.53	3.94	1.39	3.43	1.53	2.87
5.06	7.24	1.70	6.07	1.70	5.37	1.62	4.51	1.53	3.43	1.70	3.46
5.29	6.88	3.57	6.07	2.30	5.37	1.70	4.86	1.62	3.72	1.84	3.68
5.75	6.88	3.74	6.14	2.42	5.31	2.30	4.86	1.70	4.14	1.87	3.68
6.04	6.74	5.06	6.14	5.06	5.31	2.42	4.74	1.79	4.14	1.96	3.71
6.32	6.74	5.29	5.69	5.52	5.02	5.29	4.74	1.87	4.18	2.72	3.71
6.61	5.60	6.32	5.69	5.75	5.02	5.52	4.60	1.96	4.27	2.88	3.43
6.87	5.60	6.61	4.89	6.04	5.01	5.73	4.60	2.74	4.27	5.52	3.43
7.19	5.18	6.78	4.89	6.32	5.01	6.04	4.53	2.88	4.12	5.75	3.36
7.47	5.18	7.19	4.44	6.61	4.61	6.32	4.53	5.42	4.12	6.04	3.25
7.76	4.42	7.47	4.44	6.90	4.21	6.61	4.31	5.75	3.92	6.61	3.16
8.05	4.42	7.76	3.77	7.19	3.97	6.90	3.95	6.04	3.87	6.90	3.07
8.34	4.24	8.32	3.77	7.47	3.94	7.19	3.70	6.32	3.87	7.05	3.07
8.63	3.96	8.63	3.49	7.76	3.41	7.36	3.70	6.61	3.78	7.47	2.79
8.91	3.43	8.91	3.06	8.05	3.38	7.76	3.23	6.90	3.52	7.76	2.59
9.78	3.43	9.20	2.99	8.34	3.38	8.05	3.14	7.19	3.38	8.34	2.50
10.35	3.38	13.22	2.99	8.50	3.38	8.50	3.14	7.47	3.16	8.91	2.30
13.22	3.38	13.80	2.35	8.91	2.92	8.91	2.77	7.76	2.92	9.20	2.19
13.80	2.57	14.37	2.32	9.20	2.74	9.20	2.56	8.05	2.82	9.78	2.12
15.51	2.57	15.52	2.32	13.22	2.74	13.22	2.56	8.32	2.82	10.35	2.09
16.10	2.12	16.10	2.04	13.80	2.30	13.80	2.25	8.63	2.69	13.22	2.09
17.25	2.09	17.25	1.96	14.37	2.16	14.37	2.05	8.91	2.51	13.80	2.01
18.40	1.56	18.40	1.55	15.52	2.16	15.52	2.05	9.20	2.34	14.37	1.89
19.55	1.53	19.55	1.51	16.10	1.99	16.10	1.95	9.78	2.32	14.95	1.85
23.11	1.45	23.11	1.44	16.25	1.99	16.29	1.95	13.22	2.32	15.52	1.81
24.79	1.45	24.29	1.44	17.25	1.87	17.25	1.80	13.80	2.14	15.57	1.81
28.50	1.43	28.50	1.43	18.40	1.56	18.40	1.56	14.37	1.98	16.67	1.71
				19.55	1.50	19.55	1.49	14.95	1.92	18.40	1.51
				23.11	1.44	23.11	1.44	15.52	1.92	20.11	1.46
				23.94	1.44	23.61	1.44	15.62	1.92	28.50	1.42
				28.50	1.42	28.50	1.42	16.67	1.80		
								18.40	1.55		
								19.62	1.47		
								28.50	1.43		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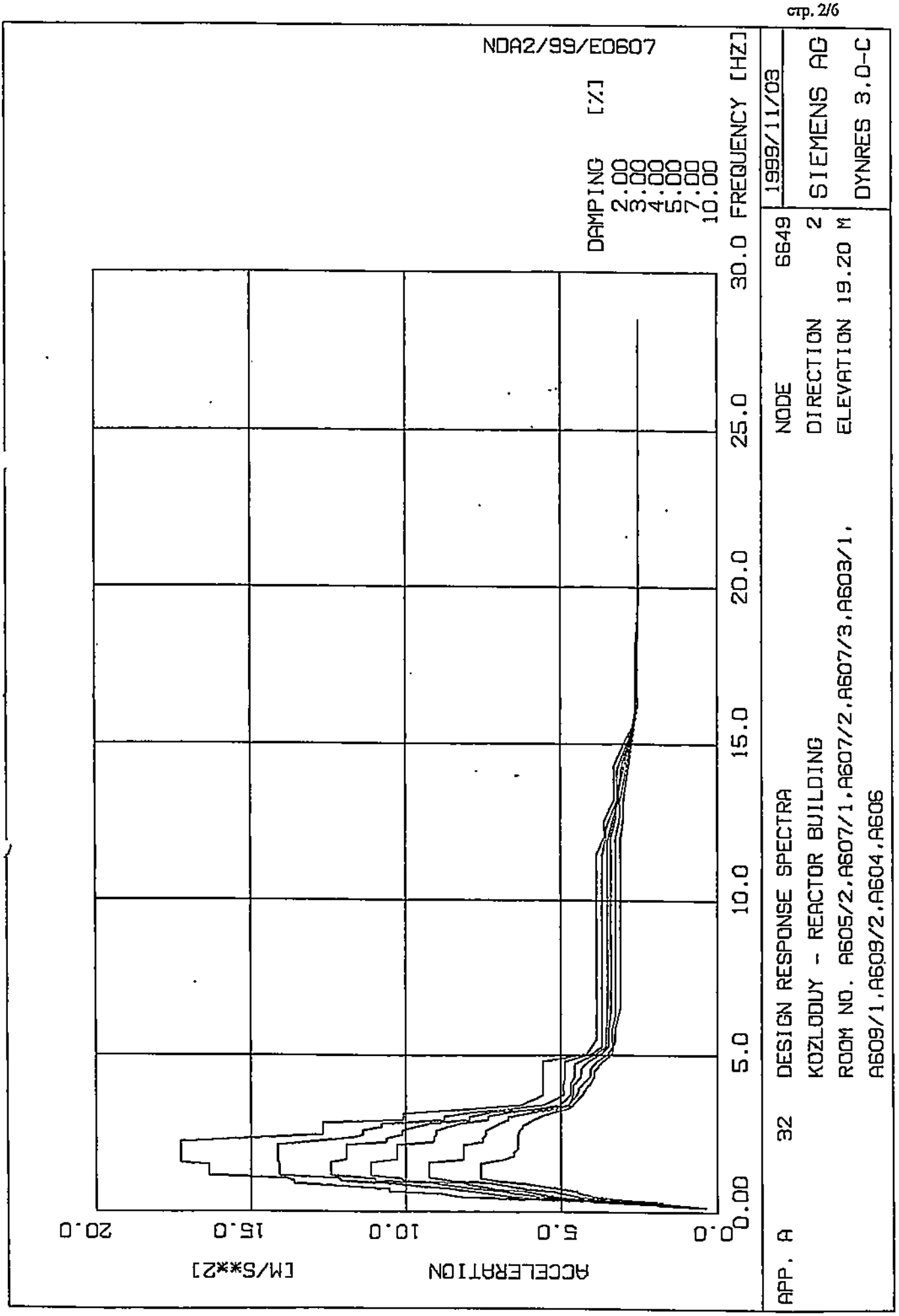
5.000
7.000
10.00
FREQUENCY [HZ]
ACCELERATION
[M/S**2]
0.00
5.0
10.0
15.0
20.0
25.0
30.0
0.0
5.0
10.0
15.0
20.0
APP. A
31 DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. A605/2,A607/1,A607/2,A607/3,A603/1,
A609/1,A609/2,A604,A606
NODE 8649
DIRECTION 1
ELEVATION 19.20 M
1999/11/09
SIEMENS AG
DYNRES 3.0-C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4.000
5.000
7.000
10.00
FREQUENCY [HZ]
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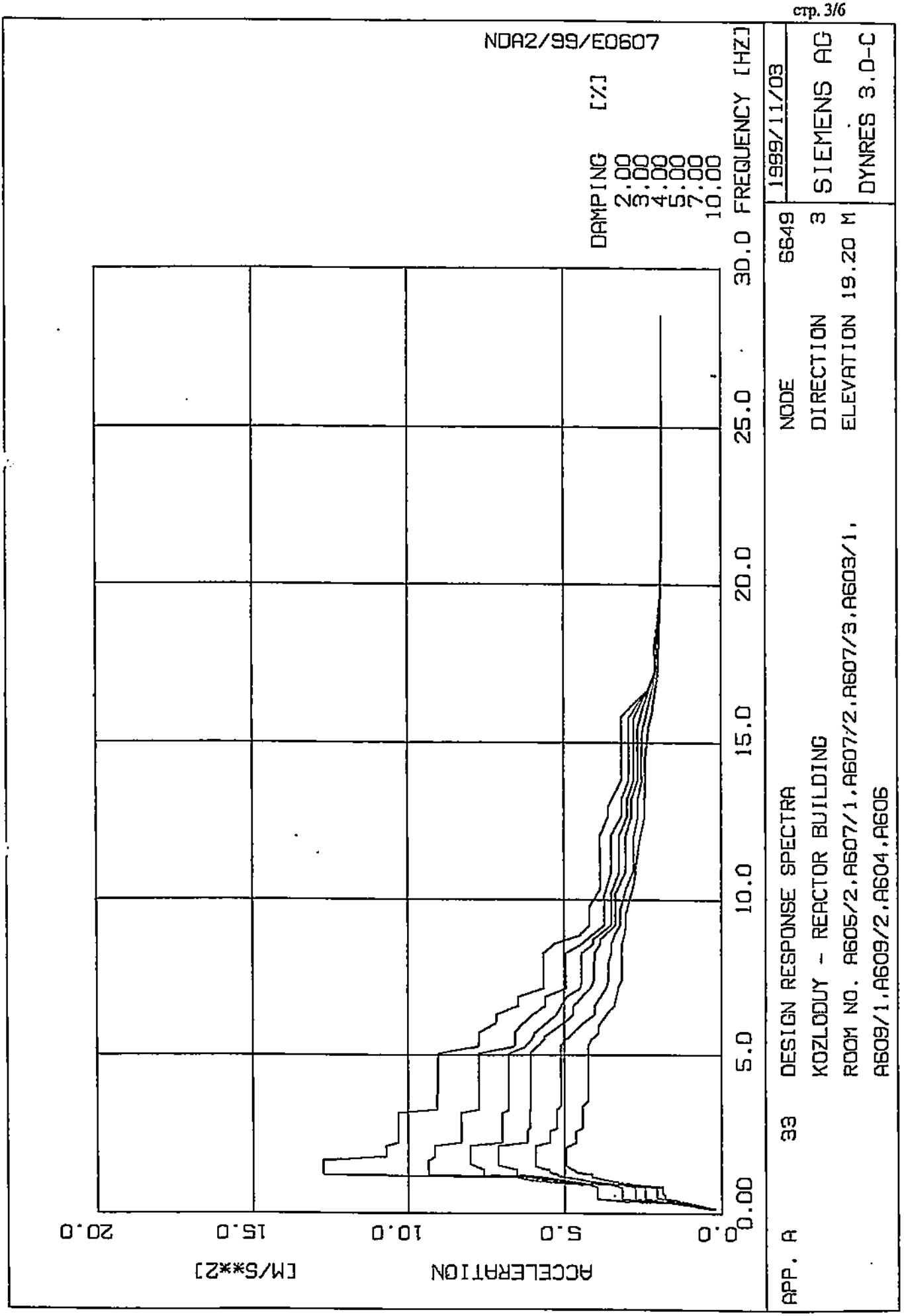
5.0
10.0
15.0
20.0
25.0
30.0
ACCELERATION
[M/S**2]
0.0
5.0
10.0
15.0
20.0
APP. A
32 DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. A605/2,A607/1,A607/2,A607/3,A603/1,
A609/1,A609/2,A604,A606
NODE 6649
DIRECTION 2
ELEVATION 19.20 M
1999/11/03
SIEMENS AG
DYNRES 3.0-C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4.00
5.00
7.00
10.00
ACCELERATION [M/S**2]
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5.0
10.0
15.0
20.0
0.00
5.0
10.0
15.0
20.0
25.0
30.0 FREQUENCY [HZ]
APP. A 33 DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. A605/2,A607/1,A607/2,A607/3,A603/1,
A609/1,A609/2,A604,A606
NODE 6649
DIRECTION 3
ELEVATION 19.20 M
1999/11/03
SIEMENS AG
DYNRES 3.0-C

DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. A605/2,A607/1,A607/2,A607/3,A603/1,
A609/1,A609/2,A604,A606

NODE 6649
DIRECTION 1
ELEVATION 19.20 M

D= 2.00 %		D= 3.00 %		D= 4.00 %		D= 5.00 %		D= 7.00 %		D=10.00 %	
FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL
0.17	0.45	0.17	0.43	0.17	0.42	0.17	0.41	0.17	0.41	0.17	0.44
0.26	2.28	0.26	2.03	0.26	1.82	0.26	1.65	0.26	1.39	0.26	1.18
0.34	3.51	0.34	3.05	0.34	2.70	0.34	2.43	0.34	2.10	0.34	1.88
0.43	7.23	0.43	5.90	0.43	4.98	0.43	4.32	0.43	3.52	0.43	2.91
0.51	8.65	0.51	6.91	0.51	5.80	0.51	5.19	0.51	4.48	0.53	4.00
0.60	9.50	0.60	7.50	0.60	6.32	0.60	5.67	0.60	4.79	0.60	4.00
0.68	10.74	0.68	8.32	0.68	7.20	0.68	6.40	0.68	5.29	0.68	4.27
0.77	10.74	0.77	8.32	0.77	7.20	0.77	6.64	0.77	5.92	0.85	5.96
0.85	12.61	0.85	9.90	0.85	8.67	0.85	7.97	0.85	6.87	0.94	6.48
1.02	13.09	0.94	11.03	0.95	10.02	0.95	9.00	0.94	7.51	1.02	6.48
1.11	13.09	1.02	11.39	1.02	10.02	1.02	9.00	1.02	7.51	1.11	7.60
1.20	17.69	1.11	12.75	1.11	11.95	1.11	11.01	1.11	9.36	1.45	7.60
1.73	17.69	1.19	14.58	1.19	12.47	1.59	11.01	1.45	9.36	1.54	7.90
1.84	15.76	1.61	14.58	1.61	12.47	1.73	10.76	1.53	9.38	2.19	7.90
2.30	15.76	1.73	13.55	1.73	11.67	2.12	10.76	2.17	9.38	2.30	7.67
2.42	15.23	1.84	12.76	2.07	11.67	2.30	10.27	2.30	9.05	2.42	7.19
2.88	15.23	2.07	12.76	2.30	11.07	2.42	9.77	2.42	8.47	2.53	6.53
2.99	11.78	2.19	12.49	2.42	10.74	2.53	9.22	2.53	7.47	2.65	6.04
3.11	10.18	2.30	12.49	2.65	10.53	2.88	9.22	2.88	7.47	2.76	5.97
3.34	8.07	2.42	12.37	2.88	10.53	2.99	8.07	2.99	6.71	2.88	5.97
3.45	5.69	2.88	12.37	2.99	9.01	3.11	7.33	3.11	6.14	2.99	5.47
3.62	5.31	2.99	10.17	3.22	7.21	3.22	6.52	3.22	5.53	3.11	4.95
3.79	5.31	3.11	9.01	3.34	6.01	3.34	5.45	3.34	4.67	3.22	4.58
3.97	5.30	3.22	8.06	3.45	4.73	3.45	4.54	3.45	4.20	3.34	4.24
4.14	4.74	3.34	6.81	3.62	4.59	3.62	4.39	3.62	4.14	3.45	4.08
4.79	4.74	3.45	4.98	3.97	4.59	3.97	4.39	3.97	4.14	3.79	3.92
5.06	4.44	3.62	4.87	4.14	4.29	4.37	4.07	4.14	4.06	4.04	3.92
5.29	4.44	3.97	4.87	4.37	4.17	4.83	3.45	4.23	4.06	4.37	3.69
5.52	3.53	4.14	4.32	4.60	3.84	5.06	3.32	4.60	3.60	4.60	3.45
5.93	3.53	4.24	4.32	4.77	3.84	5.29	3.32	4.83	3.20	4.83	3.20
6.32	3.18	4.60	4.17	5.06	3.56	5.52	3.27	5.06	3.07	5.06	3.03
8.07	3.18	4.83	4.08	5.29	3.56	5.58	3.27	5.64	3.07	5.29	2.97
8.50	3.83	5.06	3.90	5.52	3.37	6.04	3.00	6.04	2.88	5.75	2.84
11.50	3.83	5.29	3.90	5.75	3.26	6.32	2.96	6.32	2.75	6.32	2.66
12.07	3.58	5.52	3.47	5.88	3.26	13.22	2.96	13.12	2.75	6.90	2.65
13.22	3.58	5.58	3.47	6.32	3.13	13.80	2.77	13.80	2.68	12.65	2.65
14.37	3.29	6.04	3.34	13.22	3.13	14.95	2.73	14.95	2.61	13.60	2.63
15.23	3.29	11.50	3.34	13.80	2.87	15.52	2.73	16.09	2.61	15.52	2.53
16.10	2.94	12.07	3.34	14.95	2.84	16.10	2.69	16.67	2.56	16.10	2.53
16.67	2.64	13.22	3.34	15.52	2.84	17.25	2.53	20.70	2.47	20.70	2.47
17.25	2.64	13.80	3.09	16.10	2.73	23.11	2.46	28.50	2.46	28.50	2.46
19.55	2.49	14.95	2.99	17.25	2.54	27.95	2.46				
28.50	2.47	15.52	2.99	23.11	2.46	28.50	2.46				
		16.10	2.78	27.95	2.46						
		16.67	2.57	28.50	2.46						
		17.25	2.56								
		19.55	2.48								
		28.50	2.47								

DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. A605/2,A607/1,A607/2,A607/3,A603/1,
A609/1,A609/2,A604,A606

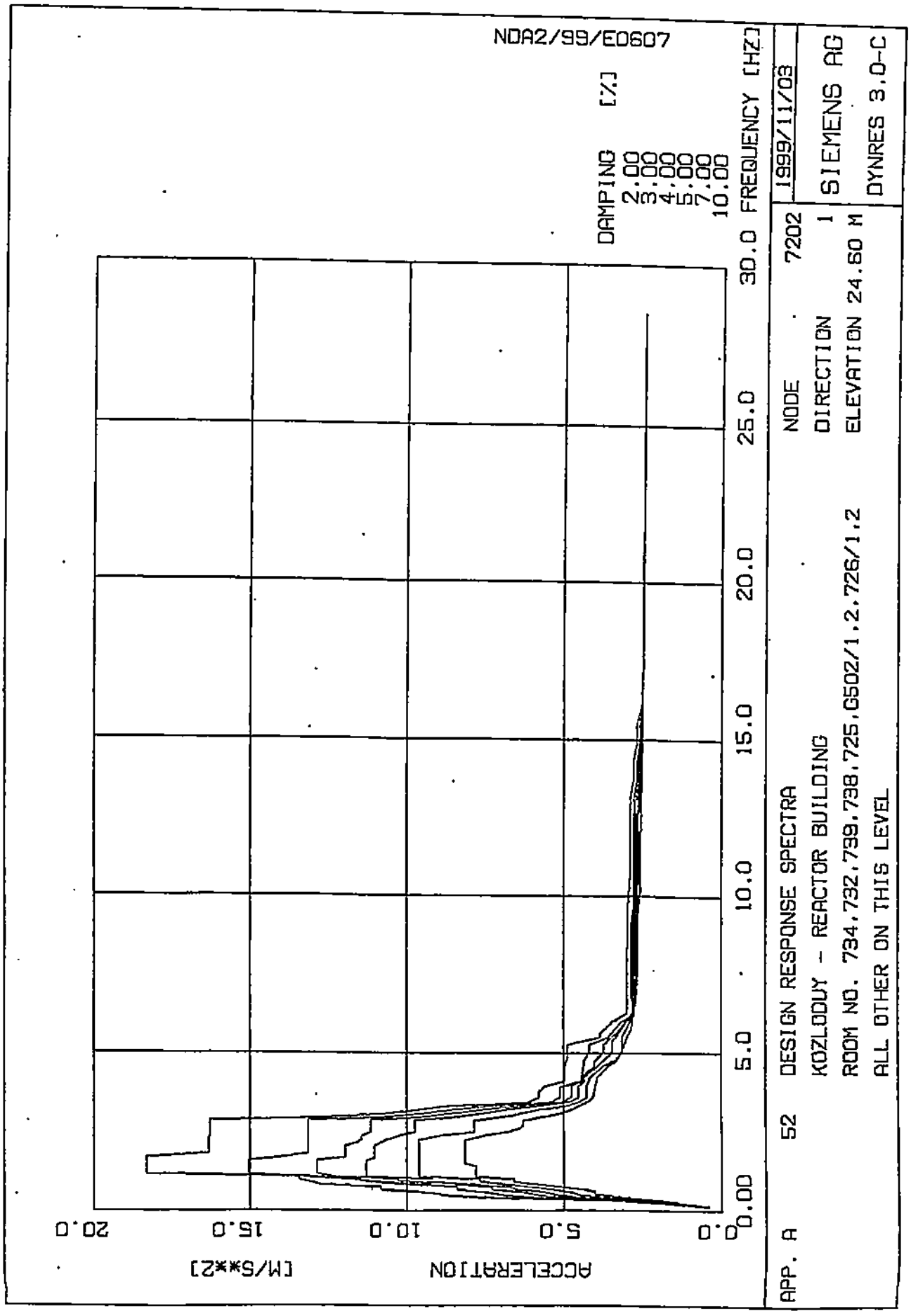
NODE 6649
DIRECTION 2
ELEVATION 19.20 M

D= 2.00 %		D= 3.00 %		D= 4.00 %		D= 5.00 %		D= 7.00 %		D=10.00 %	
FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL
0.17	0.42	0.17	0.42	0.17	0.41	0.17	0.40	0.17	0.40	0.17	0.39
0.34	4.09	0.26	2.01	0.26	1.85	0.26	1.72	0.26	1.52	0.26	1.33
0.43	6.41	0.34	3.26	0.34	2.77	0.34	2.52	0.34	2.21	0.34	1.96
0.51	8.23	0.43	5.26	0.43	4.71	0.43	4.28	0.43	3.66	0.43	3.07
0.60	8.86	0.51	6.59	0.51	5.59	0.51	5.11	0.51	4.47	0.51	3.91
0.68	10.55	0.60	7.34	0.60	6.45	0.60	5.81	0.60	4.99	0.63	4.48
0.77	10.55	0.77	8.59	0.68	6.90	0.68	6.17	0.68	5.28	0.68	4.48
0.85	12.33	0.85	9.85	0.77	7.82	0.77	7.19	0.77	6.16	0.77	5.01
0.94	13.61	0.94	10.59	0.85	8.65	0.85	7.83	0.85	6.74	0.85	5.70
1.02	13.61	1.02	12.09	0.94	9.15	0.94	8.14	0.94	7.17	0.94	6.16
1.11	13.79	1.11	12.17	1.02	10.98	1.02	10.04	1.02	8.55	1.02	7.03
1.19	16.35	1.19	14.09	1.11	10.98	1.11	10.18	1.13	9.25	1.11	7.58
1.53	16.35	1.53	14.09	1.19	12.41	1.19	11.12	1.61	9.25	1.58	7.58
1.62	17.26	1.62	14.13	1.61	12.41	1.61	11.12	1.73	8.13	1.73	6.85
2.29	17.26	2.19	14.13	1.73	11.92	1.73	10.30	2.19	8.13	1.84	6.50
2.42	14.64	2.42	11.76	2.19	11.92	2.19	10.30	2.30	7.53	1.95	6.50
2.53	12.67	2.53	11.38	2.30	10.62	2.30	9.11	2.42	7.53	2.07	6.39
2.88	12.67	2.65	11.38	2.39	10.62	2.41	9.11	2.53	7.41	2.53	6.39
2.99	10.10	2.76	10.79	2.53	10.12	2.53	9.03	2.65	7.41	2.65	6.33
3.20	10.10	2.86	10.79	2.65	10.12	2.65	9.03	2.88	6.97	2.76	6.21
3.34	8.13	2.99	8.78	2.76	9.69	2.76	8.70	2.99	6.68	2.81	6.21
3.45	6.29	3.11	8.78	2.88	9.17	2.88	8.25	3.07	6.68	2.99	5.91
3.62	5.96	3.22	7.95	2.99	7.95	2.99	7.35	3.22	5.94	3.11	5.65
3.79	5.57	3.34	6.81	3.11	7.95	3.11	7.35	3.34	5.11	3.22	5.26
4.83	5.57	3.45	5.61	3.22	7.25	3.22	6.69	3.45	4.74	3.34	4.82
5.06	4.19	3.62	5.23	3.34	6.05	3.34	5.59	3.79	4.49	3.45	4.61
5.52	3.87	3.79	4.92	3.45	5.03	3.45	4.75	3.97	4.42	3.79	4.32
11.50	3.87	4.14	4.92	3.62	4.88	3.79	4.62	4.01	4.42	3.97	4.21
12.07	3.62	4.37	4.87	3.79	4.70	4.05	4.62	4.37	4.08	4.14	4.08
12.55	3.62	4.82	4.87	4.12	4.70	4.37	4.35	4.60	4.08	4.37	3.95
13.22	3.29	5.06	4.04	4.37	4.56	4.60	4.35	4.83	3.84	4.49	3.95
14.30	3.29	5.29	3.69	4.75	4.56	4.83	4.12	5.06	3.48	4.83	3.65
14.95	3.00	5.52	3.67	5.06	3.89	5.06	3.74	5.29	3.36	5.06	3.37
15.52	2.73	5.92	3.67	5.29	3.56	5.29	3.48	5.92	3.36	5.52	3.26
16.10	2.61	6.32	3.67	5.90	3.56	5.90	3.48	6.32	3.24	5.85	3.26
18.25	2.61	11.50	3.67	6.61	3.51	6.61	3.39	12.07	3.24	6.61	3.08
19.55	2.52	12.07	3.56	11.93	3.51	12.07	3.39	12.65	3.12	12.07	3.08
28.50	2.51	12.33	3.56	12.65	3.31	12.65	3.23	13.15	3.12	12.65	3.00
		13.22	3.20	13.22	3.15	13.04	3.23	15.52	2.66	13.15	3.00
		14.18	3.20	13.71	3.15	14.37	2.96	16.67	2.57	16.10	2.57
		15.52	2.69	14.37	3.03	15.52	2.68	17.97	2.56	18.40	2.54
		16.10	2.59	15.52	2.68	16.67	2.58	19.55	2.52	28.50	2.51
		18.24	2.59	16.67	2.58	17.98	2.58	28.50	2.51		
		19.55	2.52	18.34	2.58	19.55	2.52				
		28.50	2.51	19.55	2.52	28.50	2.51				
				28.50	2.51						

DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. A605/2,A607/1,A607/2,A607/3,A603/1,
A609/1,A609/2,A604,A606

NODE 6649
DIRECTION 3
ELEVATION 19.20 M

D= 2.00 %		D= 3.00 %		D= 4.00 %		D= 5.00 %		D= 7.00 %		D=10.00 %	
FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL
0.17	0.23	0.17	0.22	0.17	0.22	0.17	0.21	0.17	0.20	0.17	0.20
0.26	1.03	0.26	0.94	0.26	0.87	0.26	0.80	0.26	0.70	0.26	0.59
0.34	1.62	0.34	1.44	0.34	1.31	0.34	1.21	0.34	1.07	0.54	1.82
0.43	3.11	0.43	2.55	0.43	2.16	0.43	1.88	0.43	1.56	0.60	1.82
0.51	3.97	0.51	3.17	0.51	2.75	0.51	2.43	0.53	2.07	0.68	1.90
0.85	3.97	0.85	3.17	0.85	2.75	0.85	2.43	0.85	2.07	0.85	1.90
0.94	4.19	0.94	3.52	0.94	3.12	0.94	2.91	0.94	2.64	0.94	2.35
1.02	5.34	1.04	5.55	1.02	4.84	1.02	4.47	1.02	3.83	1.02	3.13
1.11	6.10	1.11	5.55	1.11	5.37	1.19	5.70	1.11	4.44	1.11	3.65
1.19	6.50	1.19	6.24	1.19	6.03	1.28	6.52	1.22	5.21	1.19	4.16
1.28	12.74	1.28	9.35	1.28	7.57	1.45	6.52	1.28	5.21	1.28	4.16
1.73	12.74	1.73	9.35	1.45	7.57	1.57	7.12	1.36	5.47	1.36	4.65
1.84	10.71	1.84	9.16	1.62	8.00	2.19	7.12	1.45	5.53	1.45	4.71
2.19	10.71	2.19	9.16	2.19	8.00	2.30	6.17	1.53	5.91	1.53	4.96
2.30	10.33	2.30	8.31	2.30	6.98	2.65	6.17	2.17	5.91	2.14	4.96
3.22	10.33	3.22	8.31	3.22	6.98	2.76	6.10	2.30	5.44	2.30	4.65
3.34	9.08	3.34	7.73	3.34	6.78	3.34	6.10	2.65	5.44	2.65	4.65
3.79	9.08	5.06	7.73	5.06	6.78	3.45	6.06	2.76	5.24	2.76	4.44
3.97	9.06	5.29	6.59	5.29	6.23	5.06	6.06	3.34	5.24	2.88	4.43
5.06	9.06	5.52	6.57	5.52	6.01	5.29	5.86	3.45	5.12	3.39	4.43
5.29	7.73	5.75	6.57	5.75	5.94	5.52	5.63	5.29	5.12	3.62	4.24
5.75	7.73	6.04	6.29	6.32	5.25	5.62	5.63	5.52	4.95	5.29	4.24
6.04	7.18	6.32	5.98	6.90	4.94	6.04	5.03	6.04	4.40	5.52	4.15
6.32	7.15	6.61	5.60	7.19	4.51	6.32	4.73	6.32	4.06	5.75	3.92
6.61	6.46	6.90	5.60	7.47	4.45	6.55	4.73	6.59	4.06	5.95	3.92
6.90	6.46	7.19	4.96	8.34	4.45	6.90	4.44	7.19	3.70	6.32	3.66
7.19	5.65	8.34	4.96	8.63	4.10	7.19	4.17	7.47	3.61	6.61	3.41
8.34	5.65	8.63	4.46	8.78	4.10	7.47	4.08	8.05	3.61	6.70	3.41
8.63	5.32	8.91	4.13	9.20	3.49	8.05	4.08	8.34	3.50	7.19	3.29
8.91	4.49	9.20	3.72	10.23	3.49	8.34	4.06	8.63	3.50	7.47	3.15
9.20	4.20	10.14	3.72	10.92	3.23	8.63	3.86	8.91	3.39	8.63	3.15
9.77	4.20	10.92	3.49	12.07	3.23	8.77	3.86	9.20	3.21	8.91	3.10
10.35	3.87	12.07	3.49	12.65	3.00	9.20	3.37	9.69	3.21	9.20	3.03
12.07	3.87	12.65	3.17	13.21	3.00	10.19	3.37	10.35	3.03	9.58	3.03
12.65	3.61	13.20	3.17	13.80	2.77	10.92	3.04	10.92	2.81	10.35	2.83
12.94	3.61	13.80	2.93	15.76	2.77	12.07	3.04	11.13	2.81	10.92	2.72
13.80	3.17	15.81	2.93	16.67	2.32	12.65	2.86	12.07	2.79	11.16	2.72
15.81	3.17	16.67	2.35	17.25	2.12	13.22	2.86	12.65	2.65	12.07	2.56
16.67	2.34	17.25	2.13	19.55	1.97	13.80	2.64	13.22	2.65	12.65	2.44
17.25	2.13	17.48	2.13	23.11	1.89	15.52	2.64	13.80	2.52	13.22	2.44
18.16	2.13	19.55	1.98	27.18	1.89	16.10	2.49	15.32	2.52	13.80	2.41
19.55	1.98	23.11	1.90	28.50	1.89	16.67	2.29	16.67	2.22	14.57	2.41
23.11	1.90	28.50	1.89			17.25	2.11	17.25	2.09	15.52	2.31
28.50	1.90					19.55	1.97	18.40	1.99	16.10	2.18
						23.11	1.89	23.11	1.89	16.22	2.18
						27.95	1.89	27.95	1.89	17.25	2.04
						28.50	1.89	28.50	1.89	19.55	1.95
										20.70	1.91
										28.50	1.90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4.00
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10.00
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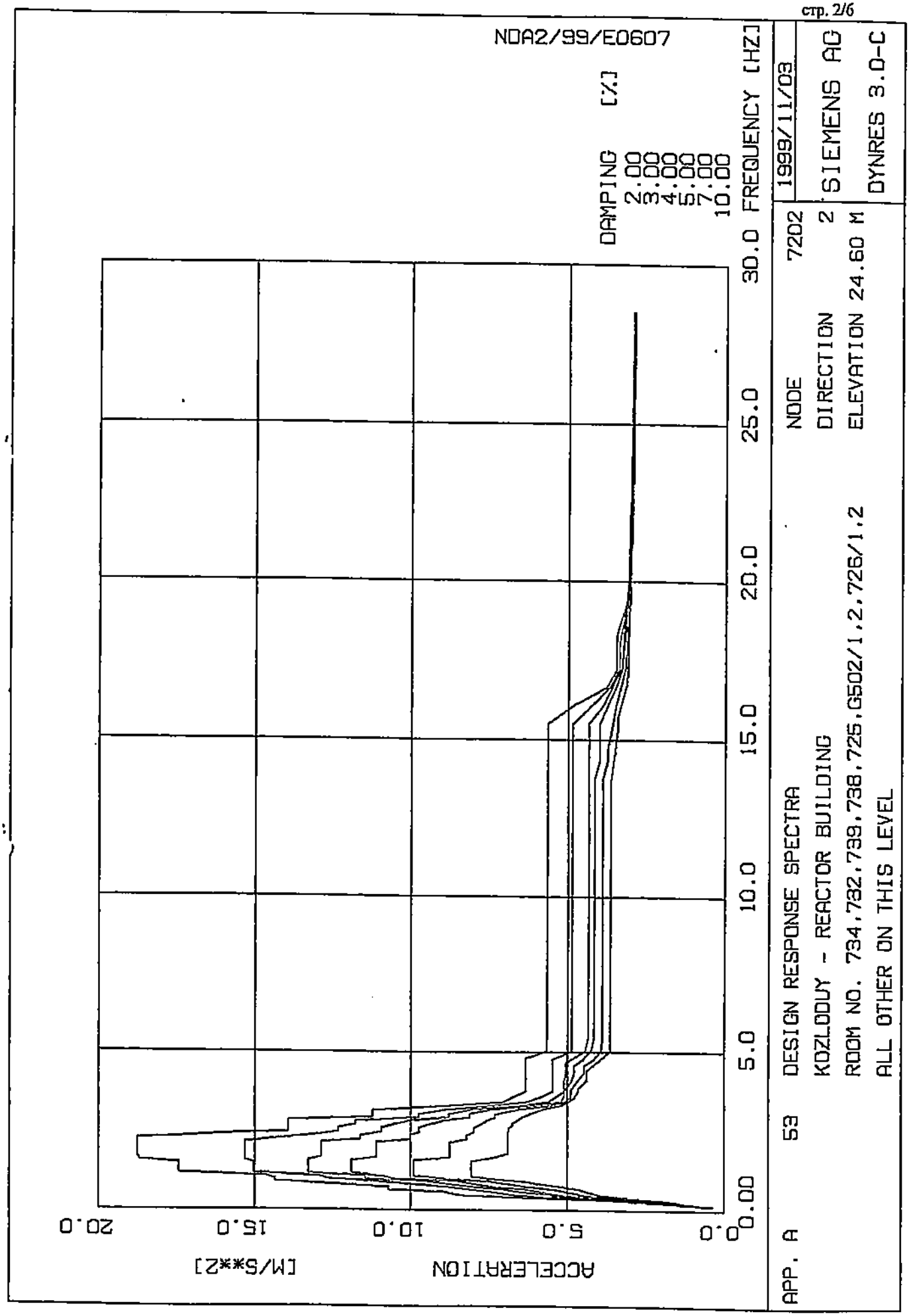
5.0
10.0
15.0
20.0
0.00
5.0
10.0
15.0
20.0
25.0
30.0 FREQUENCY [HZ]
APP. A 52 DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. 734,732,739,738,725,G502/1,2,726/1,2
ALL OTHER ON THIS LEVEL
NODE 7202
DIRECTION 1
ELEVATION 24.60 M
1999/11/03
SIEMENS AG
DYNRES 3.0-C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DAMPING [%]
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4.00
5.00
7.00
10.00
ACCELERATION [M/S**2]
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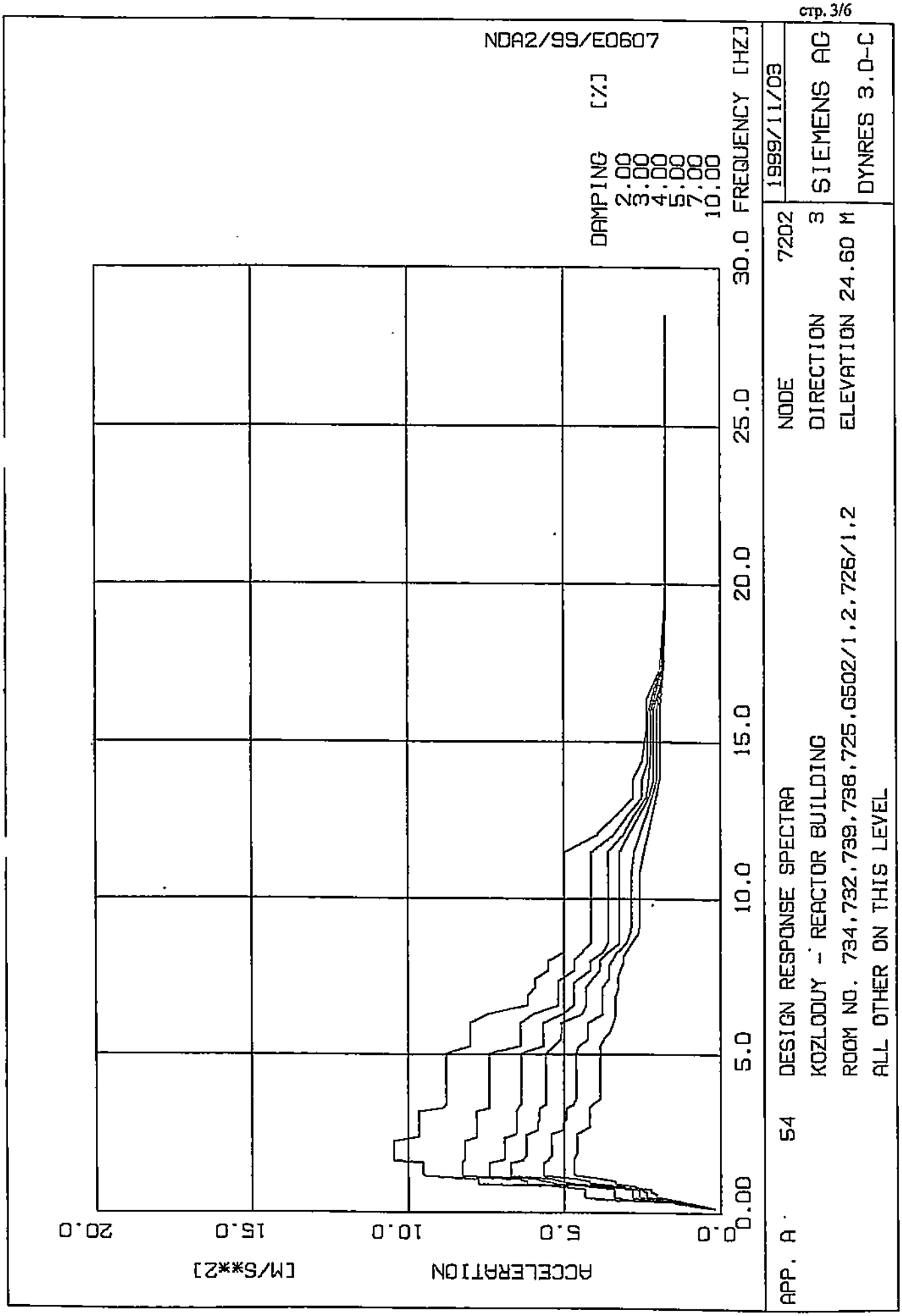
5.0
10.0
15.0
20.0
0.00
5.0
10.0
15.0
20.0
25.0
30.0 FREQUENCY [HZ]
APP. A 53 DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. 734,732,739,738,725,G502/1,2,726/1,2
ALL OTHER ON THIS LEVEL
NODE 7202
DIRECTION 2
ELEVATION 24.60 M
1999/11/03
SIEMENS AG
DYNRES 3.0-C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DAMPING [%]
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4.000
5.000
7.000
10.000
ACCELERATION [M/S**2]
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5.0
10.0
15.0
20.0
0.00
5.0
10.0
15.0
20.0
25.0
30.0 FREQUENCY [HZ]
APP. A 54
DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. 734,732,739,738,725,G502/1,2,726/1,2
ALL OTHER ON THIS LEVEL
NODE 7202
DIRECTION 3
ELEVATION 24.60 M
1999/11/03
SIEMENS AG
DYNRES 3.0-C

DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. 734,732,739,738,725,G502/1,2,726/1,2
ALL OTHER ON THIS LEVEL

NODE 7202
DIRECTION 1
ELEVATION 24.60 M

D= 2.00 %		D= 3.00 %		D= 4.00 %		D= 5.00 %		D= 7.00 %		D=10.00 %	
FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL
0.17	0.45	0.17	0.44	0.17	0.43	0.17	0.42	0.17	0.41	0.17	0.44
0.26	2.28	0.26	2.04	0.26	1.83	0.26	1.66	0.26	1.39	0.26	1.18
0.34	3.52	0.34	3.06	0.34	2.71	0.34	2.43	0.34	2.11	0.34	1.89
0.43	7.26	0.43	5.93	0.43	5.01	0.43	4.35	0.43	3.54	0.43	2.93
0.51	8.70	0.51	6.96	0.51	5.84	0.51	5.22	0.51	4.51	0.53	4.04
0.60	9.58	0.60	7.57	0.60	6.37	0.60	5.72	0.60	4.83	0.60	4.04
0.68	10.85	0.68	8.40	0.68	7.28	0.68	6.48	0.68	5.35	0.68	4.32
0.77	10.85	0.77	8.40	0.77	7.28	0.77	6.73	0.77	5.99	0.85	6.04
0.85	12.82	0.85	10.06	0.85	8.82	0.85	8.11	0.85	6.99	0.94	6.59
1.02	13.44	0.94	11.23	0.96	10.29	0.95	9.21	0.94	7.68	1.02	6.59
1.11	13.44	1.02	11.70	1.02	10.29	1.02	9.21	1.02	7.68	1.11	7.80
1.20	18.32	1.11	13.11	1.11	12.29	1.11	11.32	1.11	9.61	1.45	7.80
1.73	18.32	1.19	15.05	1.19	12.87	1.59	11.32	1.45	9.61	1.54	8.14
1.84	16.31	1.61	15.05	1.61	12.87	1.73	11.05	1.53	9.62	2.25	8.14
2.30	16.31	1.73	14.00	1.73	11.98	2.07	11.05	2.07	9.62	2.42	7.50
2.42	16.25	1.84	13.14	2.07	11.98	2.19	10.88	2.19	9.61	2.53	6.84
2.88	16.25	2.88	13.14	2.19	11.62	2.30	10.64	2.25	9.61	2.65	6.37
2.99	12.39	2.99	10.72	2.30	11.46	2.42	10.21	2.42	8.83	2.76	6.27
3.11	10.69	3.11	9.46	2.38	11.46	2.53	9.74	2.53	7.86	2.88	6.27
3.34	8.77	3.22	8.53	2.53	11.15	2.88	9.74	2.88	7.86	2.99	5.74
3.45	6.13	3.34	7.35	2.88	11.15	2.99	8.47	2.99	7.04	3.11	5.14
3.62	5.79	3.45	5.44	2.99	9.48	3.11	7.67	3.11	6.40	3.22	4.73
3.79	5.79	3.62	5.10	3.22	7.58	3.22	6.82	3.22	5.75	3.45	4.27
3.97	5.61	3.95	5.10	3.34	6.46	3.34	5.83	3.34	4.95	3.62	4.10
4.14	4.97	4.14	4.47	3.45	5.07	3.45	4.84	3.45	4.50	3.65	4.10
4.60	4.97	4.78	4.37	3.62	4.75	3.62	4.55	3.62	4.28	3.97	4.02
4.83	4.90	5.06	4.22	3.97	4.75	3.97	4.55	3.97	4.28	4.14	3.98
5.06	4.88	5.29	4.22	4.14	4.44	4.14	4.36	4.14	4.19	4.22	3.98
5.29	4.88	5.52	3.61	4.37	4.32	4.26	4.36	4.24	4.19	4.60	3.61
5.52	3.85	6.04	3.16	4.60	4.04	4.60	3.93	4.60	3.76	4.83	3.33
5.68	3.85	6.32	2.84	4.71	4.04	5.06	3.47	4.83	3.36	5.06	3.16
6.04	3.49	6.59	2.83	5.06	3.76	5.40	3.47	5.06	3.16	5.13	3.16
6.32	3.01	6.80	2.89	5.29	3.76	5.75	3.21	5.52	3.16	5.52	3.00
8.35	3.01	9.20	2.89	5.75	3.30	6.32	2.81	5.75	3.06	5.75	2.91
8.91	2.99	9.77	2.80	6.32	2.83	7.32	2.79	6.04	2.91	6.32	2.79
9.78	2.99	13.18	2.80	9.20	2.83	9.20	2.79	6.61	2.75	7.76	2.68
10.92	2.92	13.80	2.71	9.77	2.75	9.77	2.72	7.06	2.73	9.45	2.68
11.50	2.92	14.37	2.71	13.08	2.75	11.50	2.71	9.22	2.73	10.35	2.60
12.65	2.90	14.95	2.63	13.80	2.66	12.65	2.71	10.92	2.64	12.07	2.59
13.22	2.90	15.52	2.63	14.37	2.66	14.37	2.62	12.65	2.64	14.60	2.55
13.80	2.80	16.13	2.55	15.52	2.59	14.95	2.58	14.37	2.58	28.50	2.50
14.37	2.80	17.25	2.52	16.10	2.54	15.52	2.56	20.70	2.49		
14.95	2.69	28.50	2.49	16.28	2.54	17.25	2.52	28.50	2.48		
15.52	2.69			17.25	2.52	28.50	2.49				
16.10	2.56			28.50	2.49						
17.25	2.52										
28.50	2.49										

DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. 734,732,739,738,725,G502/1,2,726/1,2
ALL OTHER ON THIS LEVEL

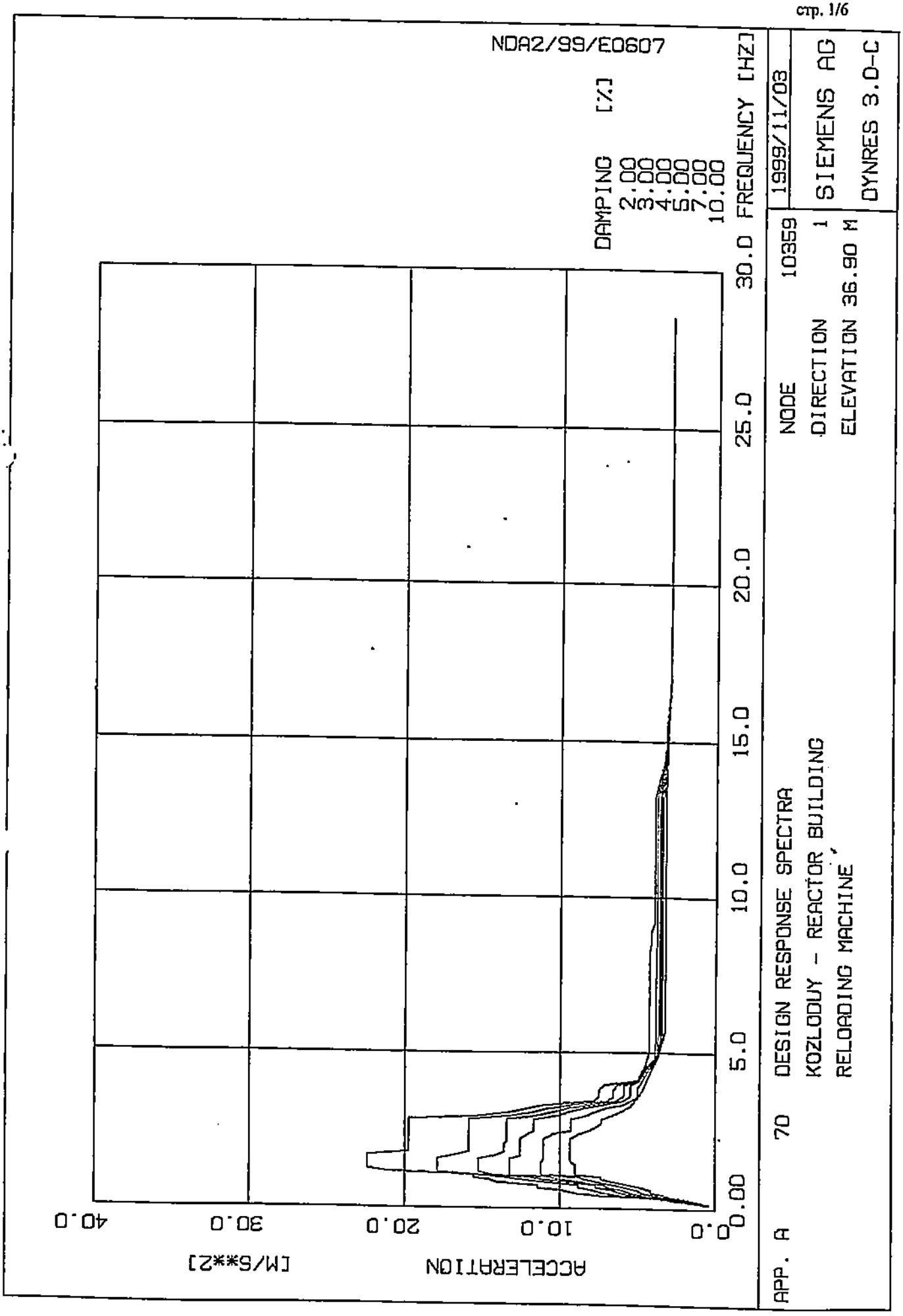
NODE 7202
DIRECTION 2
ELEVATION 24.60 M

D= 2.00 %		D= 3.00 %		D= 4.00 %		D= 5.00 %		D= 7.00 %		D=10.00 %	
FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL
0.17	0.42	0.17	0.42	0.17	0.41	0.17	0.41	0.17	0.40	0.17	0.39
0.34	4.11	0.26	2.02	0.26	1.86	0.26	1.73	0.26	1.53	0.26	1.34
0.43	6.46	0.34	3.28	0.34	2.78	0.34	2.54	0.34	2.23	0.34	1.97
0.51	8.33	0.43	5.31	0.43	4.76	0.43	4.32	0.43	3.69	0.43	3.10
0.60	8.98	0.51	6.68	0.60	6.55	0.51	5.17	0.51	4.53	0.51	3.96
0.68	10.71	0.60	7.45	0.68	7.05	0.60	5.90	0.60	5.07	0.60	4.37
0.77	10.71	0.77	8.82	0.77	8.03	0.68	6.34	0.68	5.44	0.68	4.62
0.85	12.77	0.85	10.23	0.85	8.92	0.77	7.38	0.77	6.32	0.77	5.14
0.94	14.33	0.94	11.04	0.94	9.54	0.85	8.07	0.85	6.95	0.85	5.87
1.02	14.33	1.02	12.63	1.02	11.46	0.94	8.50	0.94	7.41	0.94	6.36
1.11	14.60	1.11	12.88	1.11	11.46	1.02	10.50	1.02	8.96	1.02	7.35
1.19	17.46	1.19	15.05	1.19	13.28	1.11	10.84	1.13	9.91	1.11	8.06
1.53	17.46	1.53	15.05	1.61	13.28	1.19	11.91	1.61	9.91	1.59	8.06
1.62	18.69	1.62	15.30	1.73	12.87	1.61	11.91	1.73	8.76	1.73	7.34
1.70	18.75	2.19	15.30	2.19	12.87	1.73	11.11	2.19	8.76	1.84	6.90
2.30	18.75	2.42	13.04	2.30	11.63	2.19	11.11	2.30	8.21	1.95	6.90
2.42	16.34	2.53	12.32	2.40	11.63	2.30	10.04	2.42	8.21	2.07	6.89
2.53	13.93	2.65	12.32	2.53	10.94	2.42	10.04	2.53	7.99	2.53	6.89
2.88	13.93	2.76	11.76	2.65	10.94	2.53	9.75	2.65	7.99	2.65	6.86
2.99	11.23	2.86	11.76	2.76	10.54	2.65	9.75	2.88	7.56	2.76	6.75
3.21	11.23	2.99	9.74	2.88	10.01	2.76	9.45	2.99	7.30	2.82	6.75
3.34	9.21	3.11	9.74	2.99	8.79	2.88	8.98	3.07	7.30	2.99	6.47
3.45	7.03	3.22	8.88	3.11	8.79	2.99	8.11	3.22	6.57	3.11	6.20
3.62	6.76	3.34	7.58	3.22	8.06	3.11	8.11	3.34	5.60	3.22	5.78
3.79	6.33	3.45	6.28	3.34	6.70	3.22	7.42	3.45	5.11	3.34	5.26
4.83	6.33	3.62	5.86	3.45	5.60	3.34	6.17	3.62	4.91	3.45	4.99
5.06	5.66	3.79	5.47	3.62	5.37	3.45	5.22	3.83	4.91	3.62	4.78
15.52	5.66	4.80	5.47	3.79	5.11	3.62	5.12	4.14	4.66	3.79	4.67
16.10	4.83	5.06	4.87	4.12	5.11	3.78	5.12	4.37	4.49	3.84	4.67
16.67	3.80	15.52	4.87	4.37	5.05	4.14	4.88	4.60	4.49	4.14	4.42
17.25	3.47	16.67	3.69	4.71	5.05	4.37	4.80	4.83	4.15	4.43	4.42
18.40	3.47	17.25	3.39	5.06	4.46	4.60	4.80	5.06	3.97	4.83	3.95
19.55	3.13	18.09	3.39	5.52	4.36	4.83	4.49	5.52	3.92	5.06	3.66
20.27	3.13	19.55	3.13	13.80	4.36	5.06	4.28	13.80	3.92	13.74	3.66
28.50	2.98	28.50	2.97	14.37	4.36	5.52	4.19	14.37	3.75	14.95	3.50
				15.52	4.36	13.80	4.19	14.73	3.75	15.52	3.44
				16.10	3.88	14.37	4.01	16.10	3.51	15.71	3.44
				17.25	3.35	15.50	4.01	17.25	3.22	16.67	3.19
				18.40	3.26	16.67	3.49	19.55	3.09	17.25	3.15
				20.70	3.08	17.25	3.31	23.11	3.00	17.33	3.15
				28.50	2.96	18.40	3.21	28.50	2.94	23.11	2.99
						20.70	3.07			28.50	2.94
						28.50	2.96				

DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
ROOM NO. 734,732,739,738,725,G502/1,2,726/1,2
ALL OTHER ON THIS LEVEL

NODE 7202
DIRECTION 3
ELEVATION 24.60 M

D= 2.00 %		D= 3.00 %		D= 4.00 %		D= 5.00 %		D= 7.00 %		D=10.00 %	
FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL
0.17	0.25	0.17	0.24	0.17	0.24	0.17	0.23	0.17	0.23	0.17	0.22
0.26	1.06	0.26	0.97	0.26	0.89	0.26	0.83	0.26	0.73	0.26	0.63
0.34	1.56	0.34	1.40	0.34	1.26	0.34	1.16	0.34	0.99	0.34	0.92
0.43	3.40	0.43	2.76	0.43	2.31	0.43	2.02	0.43	1.71	0.43	1.46
0.51	4.35	0.51	3.42	0.51	2.82	0.53	2.63	0.54	2.38	0.54	2.07
0.77	4.35	0.77	3.42	0.77	2.82	0.68	2.63	0.68	2.38	0.60	2.07
0.85	5.42	0.85	4.50	0.85	3.93	0.77	2.67	0.77	2.51	0.68	2.22
0.94	7.75	0.94	6.17	0.94	5.23	0.85	3.65	0.85	3.22	0.77	2.28
1.11	7.75	1.02	6.17	1.02	5.63	0.94	4.67	0.96	4.22	0.85	2.77
1.19	9.47	1.11	6.44	1.11	5.89	1.02	5.12	1.02	4.22	0.94	3.41
1.28	9.54	1.19	8.27	1.19	7.38	1.11	5.39	1.11	4.58	1.02	3.41
1.53	9.54	1.61	8.27	1.61	7.38	1.19	6.69	1.19	5.64	1.11	3.78
1.62	9.57	1.73	8.20	1.73	6.93	1.61	6.69	1.61	5.64	1.19	4.58
1.70	10.49	2.30	8.20	1.84	6.91	1.73	6.31	1.73	5.50	1.28	4.69
2.30	10.49	2.42	7.82	2.38	6.91	1.84	6.21	1.84	5.39	1.73	4.69
2.42	9.69	3.22	7.82	2.53	6.54	2.49	6.21	2.51	5.39	1.96	4.59
3.22	9.69	3.34	7.39	2.65	6.51	2.65	5.85	2.65	5.04	2.53	4.59
3.34	8.92	5.06	7.39	3.22	6.51	2.86	5.85	2.84	5.04	2.76	4.20
3.45	8.80	5.29	6.38	3.34	6.46	2.99	5.77	2.99	4.94	3.34	4.20
5.06	8.80	6.04	6.38	3.45	6.34	3.34	5.77	3.34	4.94	3.45	4.09
5.29	8.01	6.32	5.98	5.06	6.34	3.45	5.58	3.45	4.71	3.62	3.87
6.04	8.01	6.61	5.18	5.29	5.66	5.06	5.58	3.62	4.62	3.79	3.86
6.32	7.42	7.40	5.18	6.04	5.66	5.52	5.08	5.06	4.62	3.97	3.86
6.61	6.14	7.76	4.66	6.32	5.06	6.04	5.08	5.29	4.53	5.29	3.86
6.90	6.14	8.05	4.66	6.61	4.70	6.32	4.44	5.52	4.26	5.52	3.74
7.19	5.91	8.63	4.14	7.35	4.70	6.61	4.32	5.75	4.24	5.75	3.54
7.47	5.91	11.50	4.14	7.76	4.18	7.19	4.32	6.04	4.24	6.04	3.45
7.76	5.51	12.07	3.41	8.05	4.18	7.47	4.09	6.32	3.77	6.32	3.37
8.05	5.51	12.65	2.99	8.34	3.77	7.76	3.88	7.19	3.77	6.90	3.37
8.34	4.99	13.22	2.52	8.63	3.61	8.05	3.88	7.47	3.58	7.19	3.30
11.50	4.99	13.80	2.52	11.50	3.61	8.34	3.59	7.89	3.58	7.47	3.29
12.07	3.94	14.37	2.34	12.07	3.12	8.63	3.25	8.34	3.31	7.54	3.29
13.22	2.81	15.85	2.34	12.65	2.77	11.50	3.25	8.63	3.01	8.05	3.12
13.80	2.81	16.67	2.12	13.22	2.40	13.22	2.32	8.91	2.91	8.17	3.12
14.37	2.53	17.25	1.92	13.80	2.30	13.80	2.16	9.20	2.87	8.91	2.64
15.52	2.36	19.55	1.81	14.95	2.22	15.97	2.16	10.92	2.87	9.20	2.60
16.10	2.36	28.50	1.77	15.99	2.22	16.67	1.98	11.50	2.78	10.85	2.60
16.35	2.36			16.67	2.04	17.25	1.87	12.65	2.39	11.50	2.47
17.25	1.96			17.25	1.89	19.55	1.80	13.80	2.06	12.65	2.22
19.55	1.82			19.55	1.81	20.70	1.79	14.37	2.06	13.80	1.98
28.50	1.77			28.50	1.77	21.17	1.79	14.95	2.05	15.52	1.96
						28.50	1.76	16.01	2.05	16.10	1.95
								16.67	1.94	16.19	1.95
								17.25	1.83	17.25	1.83
								19.27	1.80	18.86	1.80
								28.50	1.77	28.50	1.77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5.00
7.00
10.00
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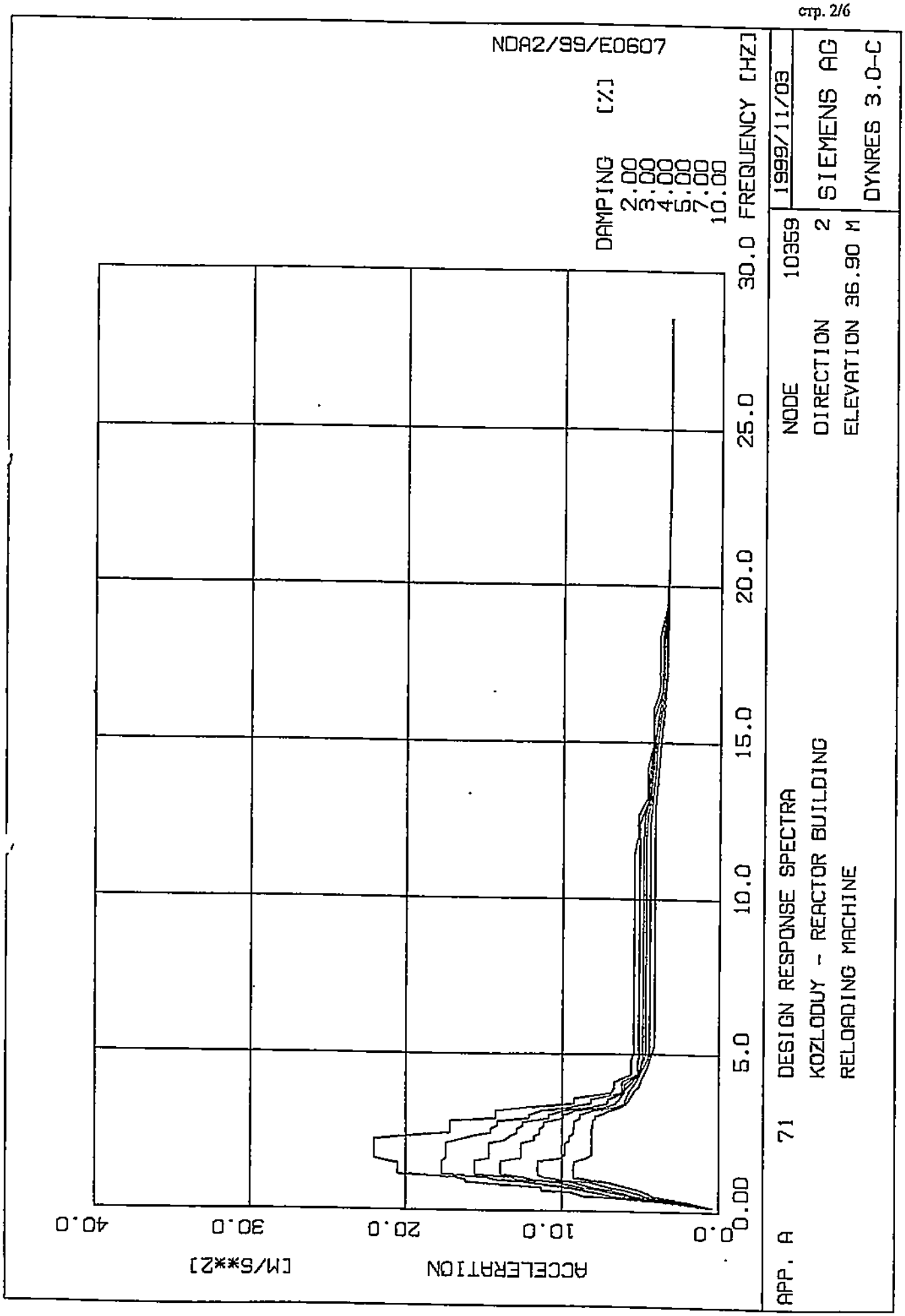
20.0
30.0
40.0
0.00
5.0
10.0
15.0
20.0
25.0
30.0 FREQUENCY [HZ]
APP. A
70 DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
RELOADING MACHINE
NODE 10359
DIRECTION 1
ELEVATION 36.90 M
1999/11/03
SIEMENS AG
DYNRES 3.0-C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DAMPING [%]
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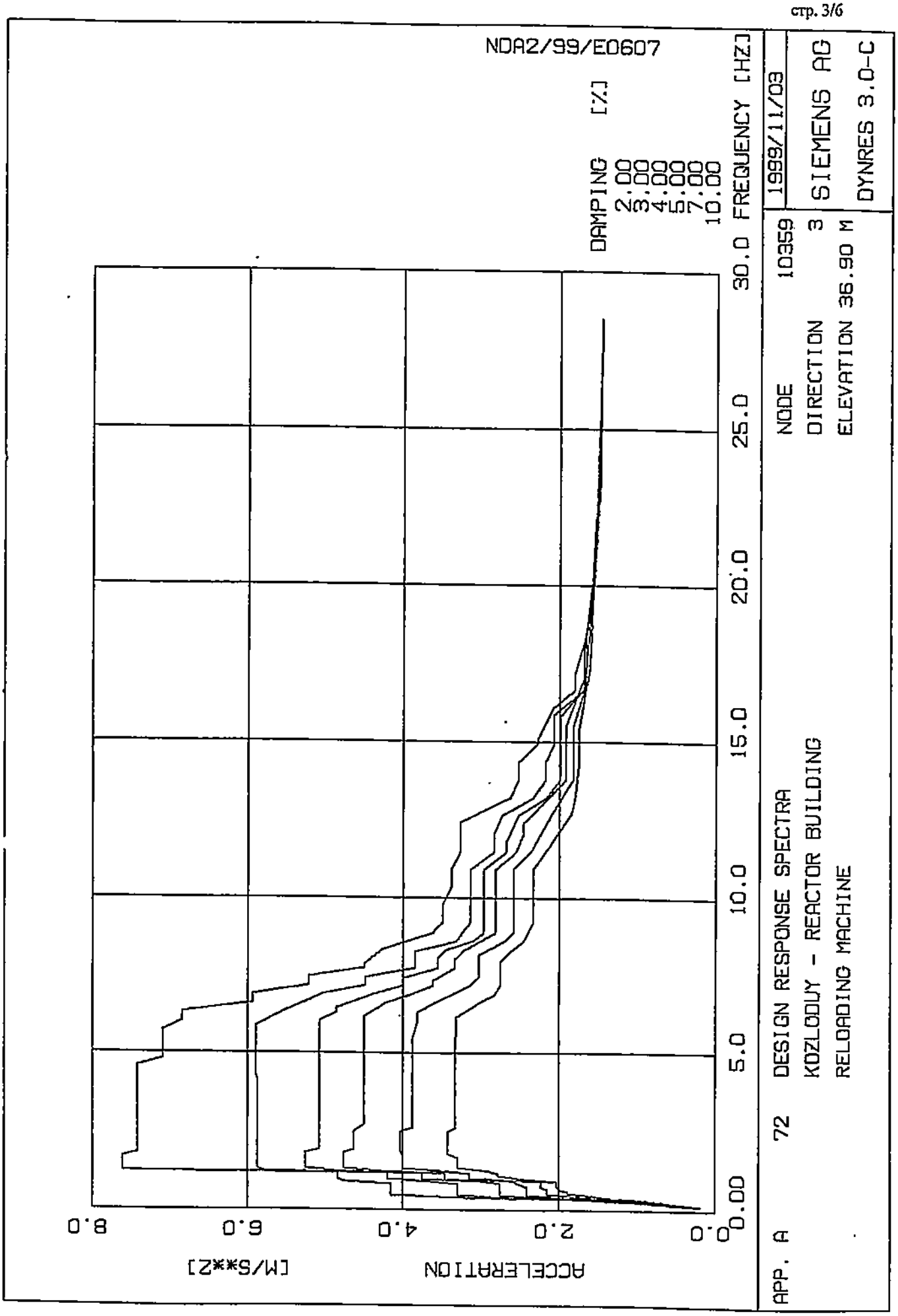
3.00
4.00
5.00
7.00
10.00
ACCELERATION [M/S**2]
0.0
10.0
20.0
30.0
40.0
0.00
5.0
10.0
15.0
20.0
25.0
30.0 FREQUENCY [HZ]
APP. A
71 DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
RELOADING MACHINE
NODE 10359
DIRECTION 2
ELEVATION 36.90 M
1999/11/03
SIEMENS AG
DYNRES 3.0-C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3.000
4.000
5.000
7.000
10.00
ACCELERATION [M/S**2]
FREQUENCY [HZ]
0.0
2.0
4.0
6.0
8.0
0.00
5.0
10.0
15.0
20.0
25.0
30.0
APP. A
72 DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
RELOADING MACHINE
NODE 10359
DIRECTION 3
ELEVATION 36.90 M
1999/11/03
SIEMENS AG
DYNRES 3.0-C

DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
RELOADING MACHINE

NODE 10359
DIRECTION 1
ELEVATION 36.90 M

D= 2.00 %		D= 3.00 %		D= 4.00 %		D= 5.00 %		D= 7.00 %		D=10.00 %	
FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL
0.17	0.45	0.17	0.44	0.17	0.43	0.17	0.42	0.17	0.42	0.17	0.45
0.26	2.31	0.26	2.06	0.26	1.85	0.26	1.68	0.26	1.42	0.26	1.21
0.34	3.56	0.34	3.09	0.34	2.73	0.34	2.46	0.34	2.17	0.34	1.96
0.43	7.46	0.43	6.10	0.43	5.15	0.43	4.48	0.43	3.68	0.43	3.06
0.51	9.02	0.51	7.22	0.51	6.08	0.51	5.41	0.51	4.69	0.53	4.22
0.60	10.05	0.60	7.94	0.60	6.67	0.60	5.98	0.60	5.06	0.60	4.22
0.68	11.43	0.68	8.87	0.68	7.73	0.68	6.88	0.68	5.69	0.68	4.61
0.77	11.43	0.77	8.87	0.77	7.73	0.77	7.21	0.77	6.43	0.77	5.51
0.85	14.09	0.85	11.07	0.85	9.67	0.85	8.89	0.85	7.67	0.85	6.55
0.94	14.52	0.94	12.49	0.94	11.09	0.94	10.05	0.94	8.50	0.95	7.36
1.02	15.58	1.02	13.59	1.02	11.96	1.02	10.65	1.02	8.84	1.02	7.36
1.11	15.58	1.11	15.29	1.11	14.35	1.11	13.21	1.11	11.21	1.11	9.09
1.19	21.30	1.19	17.90	1.19	15.27	1.19	13.23	1.50	11.21	1.45	9.09
1.28	22.42	1.61	17.90	1.61	15.27	1.61	13.23	1.61	11.07	1.56	9.38
1.73	22.42	1.73	16.97	1.73	14.20	1.73	12.54	2.27	11.07	2.27	9.38
1.84	19.78	1.84	15.87	1.84	13.59	2.27	12.54	2.42	10.46	2.42	8.88
2.88	19.78	2.88	15.87	2.07	13.59	2.42	12.08	2.53	9.32	2.53	8.19
2.99	15.23	2.99	13.11	2.19	13.42	2.53	11.65	2.88	9.32	2.65	7.70
3.11	13.34	3.11	11.80	2.30	13.42	2.88	11.65	2.99	8.42	2.76	7.36
3.34	11.11	3.22	10.74	2.42	13.41	2.99	10.29	3.11	7.91	2.88	7.34
3.45	7.90	3.34	9.22	2.88	13.41	3.11	9.53	3.22	7.13	3.11	6.29
3.62	7.53	3.45	7.02	2.99	11.54	3.22	8.53	3.34	6.05	3.22	5.81
3.79	7.53	3.62	6.58	3.11	10.56	3.34	7.19	3.45	5.53	3.34	5.45
3.97	7.14	3.79	6.58	3.22	9.51	3.45	6.07	3.62	5.06	3.45	5.24
4.14	4.97	3.97	6.31	3.34	8.04	3.62	5.54	3.86	5.06	3.79	4.73
4.23	4.97	4.14	5.02	3.45	6.49	3.94	5.50	4.60	4.16	4.14	4.47
4.60	4.57	4.37	4.76	3.62	5.99	4.14	4.88	4.83	3.83	4.60	4.03
5.06	4.31	4.60	4.46	3.94	5.94	4.60	4.30	5.06	3.63	4.83	3.80
8.30	4.31	4.83	3.94	4.14	4.97	4.83	3.84	5.21	3.63	5.29	3.54
8.63	4.22	5.06	3.94	4.60	4.38	5.06	3.68	5.75	3.47	5.52	3.43
8.91	4.22	5.29	3.94	4.83	3.87	5.29	3.68	13.22	3.47	5.75	3.34
9.20	4.01	5.52	3.89	5.06	3.77	5.52	3.60	14.37	3.34	6.32	3.34
13.22	4.01	8.34	3.89	5.38	3.77	13.31	3.60	15.52	3.20	13.57	3.34
14.37	3.45	8.63	3.82	5.75	3.70	14.37	3.38	17.33	3.08	14.95	3.23
14.95	3.32	13.22	3.82	13.22	3.70	15.52	3.22	28.50	2.99	17.25	3.08
15.52	3.32	13.80	3.63	13.80	3.56	16.67	3.08			28.50	2.99
16.10	3.17	14.37	3.43	14.37	3.40	16.86	3.08				
16.67	3.12	15.43	3.28	16.67	3.07	28.50	2.99				
20.70	3.03	16.10	3.16	17.94	3.07						
28.50	2.98	17.25	3.07	28.50	2.99						
		18.30	3.07								
		28.50	2.99								

DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
RELOADING MACHINE

NODE 10359
DIRECTION 2
ELEVATION+36.90 M

D= 2.00 %		D= 3.00 %		D= 4.00 %		D= 5.00 %		D= 7.00 %		D=10.00 %	
FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL
0.17	0.43	0.17	0.42	0.17	0.41	0.17	0.41	0.17	0.40	0.17	0.39
0.34	4.16	0.26	2.06	0.26	1.90	0.26	1.77	0.26	1.57	0.26	1.37
0.43	6.59	0.34	3.31	0.34	2.81	0.34	2.58	0.34	2.27	0.34	2.01
0.51	8.67	0.43	5.44	0.43	4.87	0.43	4.43	0.43	3.78	0.43	3.18
0.60	9.37	0.51	6.97	0.60	6.89	0.51	5.36	0.51	4.71	0.51	4.14
0.68	11.30	0.60	7.84	0.68	7.55	0.60	6.22	0.60	5.34	0.60	4.60
0.77	11.30	0.77	9.50	0.77	8.65	0.68	6.80	0.68	5.84	0.68	4.98
0.85	14.02	0.85	11.25	0.85	9.71	0.77	7.96	0.77	6.83	0.77	5.59
0.94	16.18	0.94	12.44	0.94	10.42	0.85	8.79	0.85	7.58	0.85	6.41
1.02	16.18	1.02	14.17	1.02	12.86	0.94	9.32	0.94	8.20	0.94	7.02
1.11	16.75	1.11	14.76	1.11	13.11	1.02	11.85	1.02	10.03	1.02	8.21
1.19	20.54	1.19	17.67	1.19	15.55	1.11	12.47	1.11	11.14	1.11	9.29
1.53	20.54	1.61	17.67	1.61	15.55	1.19	13.91	1.19	11.53	1.50	9.29
1.62	21.36	1.73	17.40	1.73	14.64	1.61	13.91	1.61	11.53	1.61	9.24
1.70	22.04	2.19	17.40	2.19	14.64	1.73	12.60	1.73	10.17	1.73	8.51
2.30	22.04	2.30	16.60	2.30	13.62	2.19	12.60	1.84	9.88	1.84	8.08
2.42	19.54	2.42	15.64	2.42	13.29	2.30	11.77	2.19	9.88	2.65	8.08
2.53	17.14	2.53	14.54	2.53	12.86	2.42	11.77	2.30	9.55	2.88	8.02
2.88	17.14	2.65	14.54	2.65	12.86	2.53	11.41	2.42	9.55	2.99	7.87
2.99	14.21	2.76	14.09	2.76	12.50	2.65	11.41	2.53	9.29	3.04	7.87
3.22	14.21	2.88	14.09	2.86	12.50	2.76	11.15	2.65	9.29	3.22	7.07
3.34	12.23	2.99	12.08	2.99	10.85	2.86	11.15	2.76	9.21	3.34	6.41
3.45	9.22	3.11	12.08	3.11	10.85	2.99	9.97	2.88	9.21	3.45	5.90
3.62	9.22	3.22	11.34	3.22	10.01	3.11	9.97	2.99	8.87	3.79	5.42
3.79	6.84	3.34	9.57	3.34	8.17	3.22	9.15	3.08	8.87	3.97	5.16
3.97	6.67	3.45	8.12	3.45	7.13	3.34	7.35	3.22	8.06	4.14	5.02
4.14	6.67	3.60	8.12	3.59	7.13	3.45	6.61	3.34	6.75	4.60	4.64
4.37	5.62	3.79	6.16	3.79	6.10	3.62	6.34	3.45	6.02	5.29	4.17
4.83	5.62	4.14	6.16	3.97	6.00	3.79	6.01	3.51	6.02	5.52	4.16
5.06	5.46	4.37	5.25	4.06	6.00	3.86	6.01	3.79	5.76	13.05	4.16
11.50	5.46	4.83	5.20	4.37	5.19	4.14	5.53	3.97	5.52	15.18	3.81
12.07	5.22	5.06	5.14	4.83	4.95	4.37	5.12	4.14	5.28	16.10	3.62
12.65	5.22	12.44	5.14	5.06	4.88	4.83	4.81	4.60	4.81	17.25	3.42
13.22	4.69	13.22	4.58	12.04	4.88	5.06	4.72	4.83	4.64	18.58	3.42
14.21	4.69	14.02	4.58	12.65	4.81	12.07	4.72	5.06	4.45	23.11	3.29
14.95	4.30	14.95	4.23	13.22	4.51	12.65	4.66	12.50	4.45	28.50	3.24
16.08	4.30	15.76	4.23	13.71	4.51	13.22	4.43	13.61	4.28		
16.67	3.89	16.67	3.72	14.37	4.34	13.65	4.43	14.37	4.10		
18.40	3.89	18.40	3.72	14.95	4.17	14.37	4.25	14.77	4.10		
19.55	3.43	19.55	3.43	15.28	4.17	14.81	4.25	17.25	3.49		
20.43	3.43	23.11	3.31	16.10	3.91	17.25	3.56	18.40	3.49		
23.11	3.31	28.50	3.25	17.25	3.63	18.40	3.56	19.55	3.43		
28.50	3.25			18.40	3.63	19.55	3.44	23.11	3.30		
				19.55	3.44	23.11	3.30	28.50	3.24		
				23.11	3.31	28.50	3.24				
				28.50	3.24						

DESIGN RESPONSE SPECTRA
KOZLODUY - REACTOR BUILDING
RELOADING MACHINE

NODE 10359
DIRECTION 3
ELEVATION 36.90 M

D= 2.00 %		D= 3.00 %		D= 4.00 %		D= 5.00 %		D= 7.00 %		D=10.00 %	
FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL	FREQ	ACCEL
0.17	0.23	0.17	0.23	0.17	0.22	0.17	0.21	0.17	0.20	0.17	0.20
0.26	1.04	0.26	0.95	0.26	0.87	0.26	0.80	0.26	0.70	0.26	0.60
0.34	1.59	0.34	1.41	0.34	1.27	0.34	1.16	0.34	0.99	0.34	0.87
0.43	3.22	0.43	2.63	0.43	2.22	0.43	1.93	0.43	1.58	0.43	1.34
0.51	4.16	0.51	3.30	0.51	2.75	0.51	2.41	0.53	2.16	0.54	1.89
0.85	4.16	0.85	3.30	0.85	2.75	0.77	2.41	0.68	2.16	0.60	1.89
0.94	4.76	0.94	3.66	0.94	3.00	0.94	2.57	0.77	2.23	0.68	2.01
1.02	4.83	1.02	4.20	1.02	3.76	1.02	3.47	0.94	2.23	0.77	2.03
1.19	4.83	1.19	4.20	1.19	3.76	1.19	3.47	1.04	3.15	0.94	2.03
1.28	7.61	1.28	5.79	1.28	4.89	1.28	4.28	1.19	3.15	1.02	2.44
1.73	7.61	1.36	5.87	1.36	5.26	1.36	4.76	1.28	3.51	1.11	2.78
1.84	7.42	4.08	5.87	1.84	5.26	1.84	4.76	1.36	4.01	1.19	2.78
4.60	7.42	4.25	5.89	1.96	5.07	1.96	4.63	1.70	4.01	1.28	2.89
4.83	7.10	5.89	5.89	6.04	5.07	2.53	4.63	1.87	4.04	1.37	3.30
5.75	7.10	6.32	5.56	6.32	4.86	2.76	4.51	2.53	4.04	1.70	3.30
6.04	6.84	6.90	5.05	6.47	4.86	5.29	4.51	2.65	3.88	1.82	3.42
6.32	6.84	7.19	4.49	6.90	4.39	5.52	4.50	5.52	3.88	2.53	3.42
6.61	5.93	7.44	4.49	7.19	4.01	6.19	4.50	6.04	3.81	2.65	3.33
6.90	5.93	7.76	3.85	7.41	4.01	6.61	4.23	6.32	3.81	5.52	3.33
7.19	5.22	8.29	3.85	7.76	3.56	6.90	3.90	6.61	3.61	5.75	3.32
7.47	5.22	8.63	3.32	8.05	3.56	7.19	3.62	7.19	3.14	6.18	3.32
7.76	4.51	9.20	3.14	8.34	3.45	7.35	3.62	7.47	3.03	6.61	3.04
7.90	4.51	10.92	3.14	8.63	3.11	7.76	3.34	8.17	3.03	6.90	2.82
8.34	4.28	11.50	2.83	8.91	2.96	8.05	3.34	8.63	2.71	7.19	2.75
8.91	3.61	12.07	2.83	10.92	2.96	8.34	3.22	8.91	2.58	7.93	2.75
9.20	3.50	12.65	2.73	11.50	2.67	8.91	2.82	10.92	2.58	8.34	2.61
9.77	3.50	13.22	2.33	11.80	2.67	10.92	2.82	11.50	2.36	8.63	2.46
10.35	3.38	13.80	2.18	12.65	2.52	11.50	2.55	12.65	2.10	8.91	2.40
10.92	3.38	14.37	2.18	13.22	2.17	12.07	2.46	13.22	1.97	9.20	2.34
11.50	3.27	14.95	2.08	13.80	1.99	12.38	2.46	13.80	1.83	10.92	2.34
12.43	3.27	15.88	2.08	15.80	1.99	13.80	1.92	15.52	1.83	12.07	2.02
13.22	2.62	16.67	1.69	16.67	1.70	15.52	1.92	16.67	1.68	12.65	1.86
13.80	2.52	18.34	1.69	18.02	1.70	17.25	1.66	18.15	1.64	13.22	1.80
14.37	2.52	19.71	1.60	19.55	1.60	18.40	1.66	19.55	1.59	14.37	1.76
14.95	2.28	23.11	1.51	23.11	1.51	19.55	1.60	23.11	1.50	15.44	1.75
15.07	2.28	28.50	1.47	28.50	1.47	23.11	1.51	28.50	1.46	17.25	1.63
16.10	2.07					28.50	1.47			19.55	1.57
16.67	1.81									23.11	1.50
17.19	1.81									28.50	1.46
18.40	1.67										
20.27	1.59										
23.11	1.53										
28.50	1.47										