Relay protection at substation for:

* two transmission 330kV lines and one CLIENT 330kV bays;
* two busbars with buscoupler.

All the paragraphs are obligatory requirements of the Purchaser (hereinafter – the Customer) unless there is remark “Informative part”.

## General requirements.

|  |  |  |  |
| --- | --- | --- | --- |
| Required: | | | Offered: |
| The bid shall include all necessary hardware (cases etc.) and software for functions and features together with all necessary auxiliary relays and connection units. | | |  |
| Licenses for all software used shall be included | | |  |
| The Customer has rights to use **any** functionality that is available in the relays. Time for commissioning shall be included in the overall time given bellow. | | |  |
| Delivered software shall be indicated in the invoice | | |  |
| In the tender technical specification form should be indicated: all types, amounts of relays, ordering codes, proposed test switches and selector switches, applicable international standards to approve the functionality of proposed software and hardware | | |  |
| Estimated service life of proposed relay protection based on microprocessors | | |  |
| Additionally, to the tender technical specifications, drawings of cubicles with equipment arrangement should be designed and submitted by the Tenderer | | |  |
| Relay protection and automation cubicles wiring tables should be designed and submitted by the Tenderer. Wiring tables shall include terminal column arrangement of relay protection cubicles with the following information:  Marking of cable wire, information shall be fulfilled after project finalization;  Terminal number in column;  Project page number where terminal is used;  Connection remote end address of wire.  (In example: / 1L+20 / 3 / 5,15,30 / Q1-F501 /,  which means, that circuit 1L+20 is connected to third terminal in column, circuit is located in pages 5, 15 and 30 of the given relay protection schemes, wire is connected to relay F501 terminal Q1)  The Customer shall approve wiring tables | | |  |
| Relay protection cubicles shall be as follows:   1. Relay protection terminals shall be installed on the front wall, front wall shall be with handle and open position fixation; 2. Backside montage plate for terminals and cable channels; 3. Plate for floor covering; 4. Bays shall be separated with left and right-side plates; 5. Door switch, key shall be included; 6. Construction for outside cable fixation; 7. Terminals for the earthing of cables and equipment; 8. For illumination of cubicles LED lamps should be used with luminous flux ≥ 600lm**;** 9. Color RAL 7032; 10. Equipment shall be arranged as shown on Attachment “Cubicle layout”. 11. **Note:** In the Attachment general arrangement of relay protection equipment and devices is depictured. | | |  |
| Participation 2 Customer’s engineers in the factory acceptance tests. | | |  |
| Wiring of all cubicles should be marked. Marking shall indicate wire remote end address. | | |  |
| Current, voltage, trip, transfer commands and pick-up information terminals shall be interruptible. For current, voltage, trip, transfer commands and pick-up information terminals test sockets (plugs) for 4mm2 test wire connection shall be included.   1. For current, voltage, trip, transfer commands, pick-up, alarm, warning and circuit breaker information URTK/S terminals shall be used\* 2. For disconnector position indication UK6N terminals shall be used\* 3. All terminals shall be wired to the protection devices, spare wires shall be left at the equipment side. 4. Wiring below construction or fixation equipment, mounting rail is not allowed.   \*Other type of terminals shall be agreed by the Customer | | |  |
| All external tripping circuits, with are connected to binary inputs, shall be separated via auxiliary relays | | |  |
| Please indicate actual time for (Informative part): | | |  |
| relay protection cubicle designing works after project documentation receiving; | insert number of days | |  |
| corrected wiring tables after commissioning; | insert number of days | |  |
| SCS commissioning time after relay protection commissioning | insert number of days | |  |
| Please indicate actual testing, check and commissioning time for bay: | | |  |
| 330kV line: | insert number of days | |  |
| busbars with bus disconnectors: | insert number of days | |  |
| repeated commissioning during reconstruction steps | insert number of days | |  |
| Note: In case of any discrepancies after ordering the Supplier is no way released from the obligation to perform entire commissioning without the Contract Price exchanges. | | |  |
| Proposed relay protection for each bay should be mounted and wired separately: | | |  |
| 330kV line protection**:**   1. dimensions of cubicle;   Such amount of main installation equipment shall be included:   1. 8 DC MCB’s, nominal current will be clarified during designing; 2. 60 URTK/S\* terminals; 3. 200 URTK/SS\* terminals; 4. 100 UK6N\* terminals; 5. 10 USLKGN 10N\* terminals; 6. 20 PA1 – 4N plugs; 7. 15 auxiliary relays with base, 3NOcontacts, nominal power at least 3W like Finder 62.33.9.110.0300 with additional diode and resistance block; 8. 6 fast auxiliary relays with base for DIN rail, 4NO contacts, ≤ 8ms tripping time; 9. **Line differential protection and teleprotection device for line remote ends shall be installed in appropriate remote end substation line bay relay protection cubicle.** | in one cubicle per line  2200 x 900 x 600 mm  (**four** cubicles at all) | |  |
| 330kV busbar bay control module   * dimensions of cubicle;   Such amount of main installation equipment shall be included:   * 4 DC MCB’s, nominal current will be clarified during designing; * 40 URTK/S\* terminals; * 100 URTK/SS\* terminals; * 100 UK6N\* terminals; * 10 USLKGN 10N\* terminals; * 20 PA1 – 4N plugs; * 10 auxiliary relays with base for DIN rail, 3NO contacts, nominal power at least 3W like Finder 62.33.9.110.0300 with additional diode and resistance block. * 6 fast auxiliary relays with base for DIN rail, 4NO contacts, ≤ 8ms tripping time. | in one cubicle  2200 x 900 x 600 mm | |  |
| Emergency automatic control modules   * dimensions of cubicle;   Such amount of main installation equipment shall be included:   * 4 DC MCB’s, nominal current will be clarified during designing; * 40 URTK/S\* terminals; * 100 URTK/SS\* terminals; * 100 UK6N\* terminals; * 10 USLKGN 10N\* terminals; * 20 PA1 – 4N plugs; * 10 auxiliary relays with base for DIN rail, 3NO contacts, nominal power at least 3W like Finder 62.33.9.110.0300 with additional diode and resistance block. * 6 fast auxiliary relays with base for DIN rail, 4NO contacts, ≤ 8ms tripping time. | in one cubicle  2200 x 900 x 600 mm | |  |
| 330kV busbar and breaker failure protection  Such amount of main installation equipment shall be included:   * 20 DC MCB’s, nominal current will be clarified during designing; URTK/S\* terminals; * 600 URTK/SS\* terminals; * 50 USLKGN 10N\* terminals; * 200 PA1 – 4N plugs; * 50 auxiliary relays with base, 3NO contacts, nominal power at least 3W like Finder 62.33.9.110.0300 with additional diode and resistance block; * 10 fast auxiliary relays with base for DIN rail, 4NO contacts, ≤ 8ms tripping time | in separate cubicle(s)  2200 x 900 x 600 mm | |  |
| Ordering code for fast trip relays |  | | |
| Delivered relay protection and automation should be entirely commissioned and co-operation of equipment checked by the Supplier. | | |  |
| The following scope of services for all delivered equipment and all substation bays where equipment will be located, excluding spare equipment, are included in the Contract Price, including for line remote ends: | | |  |
| commissioning of relay protection, including cooperation test with existing relay protection equipment, line remote ends and repeated commissioning according to the time schedule for: | | |  |
| delivered relay protection shall be connected to SCS; | | |  |
| after the final step of reconstruction setting changes for **two lines*.***  Re-commissioning shall be done in 30 days after receiving setting lists. | | |  |
| Additional configurated automation and protection functions shall be indicated and marked as tested. Information from the setting list shall be used. | | |  |
| relay protection at line remote ends shall be connected to existing SCS. | | |  |
| testing of measuring transformers:  current transformer and combined transformer current part polarity check;  current transformer and combined transformer current part ratio check;  current circuit resistance measurement;  VA characteristics shall be given according to measured values for all current and combined transformer current part windings;  current and voltage transformers, combined measurement transformers earthing check; | | |  |
| all secondary wiring check, including following:  the wiring of relay protection cubicle;  wiring of external circuits from primary equipment wiring boxes to relay protection cubicles including marshalling boxes;  secondary part bay isolation measurement using 1kV; | | |  |
| commissioner shall check that:  relay protection devices can switch on / off circuit breakers, disconnectors and earthing switches; supplier shall test that blocking scheme for disconnectors and earthing switches is working properly;  permissible, blocking, switching on-to fault, including un-successful auto recloser cycle, and other mutual relay protection and automation functions cooperation between relay protection devices, which are mentioned in setting lists. | | |  |
| After energizing the bay, the supplier shall check that RP devices are measuring correctly. The supplier must be estimated that directional and differential protection are oriented correctly. | | |  |
| connection and commissioning of modems at substations and Relay department office | | |  |
| Ethernet modem (indicate) | | 1 pc. |  |
| All necessary cables, junctions, couplers for modem connection (indicate) | | yes |  |

The Supplier shall submit the following documentation to Relay Department of AST:

a) within 30 days after the ordering:

|  |  |
| --- | --- |
| set in the Latvian or English of the following manuals in digital form: |  |
| software manual; |  |
| application manual; |  |
| technical reference manual; |  |
| installation and commissioning manual; |  |
| operator’s manual; |  |
| manuals of relay protection units. |  |

b) right after commissioning and tests:

|  |  |
| --- | --- |
| diagrams and settings in digital form. |  |
| copy of corrected cubicle wiring tables in digital form. |  |
| Protocols of performed tests and commissioning. The protocols should be written in the Latvian. Note: The takeover deed about the performed tests and commissioning will be signed by the Customer only after receipt of the protocols.  Protocols shall include the following:  Test set printouts (FREJA, OMICRON, ISA etc.) which indicate tested value and actual value in mentioned values (A, V, Ω, 0, differential, biased etc.) with actual feedback time and nominal reaction time.  Relay parameter set.  Relay configurations. |  |

Relay protection shall be designed for:

|  |  |  |
| --- | --- | --- |
| auxiliary voltage  auxiliary voltage for line remote ends | 110V DC |  |
| rated current  rated current for line remote ends | 1A |  |
| activation voltage of binary inputs by more than 50% and less than 80%  of Urate | indicate |  |

The numerical units mentioned in the Item 3 shall also include the following:

|  |  |  |  |
| --- | --- | --- | --- |
| LCD display and navigation push buttons; | | |  |
| First **optical** interface for communication with the Substation control system (SCS). Use of the IEC 61850 communication protocol is requested. KEMA A level certificate or equal shall be provided. | | |  |
| Possibility of PC connection to the IEC61850 loop. All needed wires, switches and transducers shall be delivered | | |  |
| All needed optical wires (cables) shall be delivered, including one spare wire between relay protection device and Ethernet switches (two wires or cables at all) | | |  |
| Optical cables shall be used to connect devices outside the protection cubicles | | |  |
| Ethernet switches shall include the following: | | | See below |
| * Ordering code **(Informative part)** |  | | |
| * Quantity, including one spare Ethernet switch | 6 pcs |  | |
| * Input and output memory for each port; | |  | |
| * Appropriate standards for use in electric power installations shall be delivered; | |  | |
| * Supporting of GOOSE (Generic Object-Oriented Substation Event) telegrams; | |  | |
| * FEFI (Far Error Fault Indication) support; | |  | |
| * Network monitoring using SNMP (Simple Network Management Protocol); | |  | |
| * Supply voltage 110V DC (AC adapters cannot be used); | |  | |
| * Customer made configuration of switch (with settable IP address etc.); | |  | |
| * Software for Customer’s made configuration shall be delivered; | |  | |
| * Ethernet switches shall be connected in the ring topology using redundancy protocol, for example RSTP (Rapid Spanning Tree Protocol); | |  | |
| * Broken loop shall be recognized in not less than 10ms; | |  | |
| Maintenance of separate relay protection device or Ethernet switch without disturbing rest of devices; | |  | |
| Freely configuration of information using IEC 61850 | |  | |
| Each supervision and failure indication to SCS shall be delayed for 10s; | |  | |
| During relay protection test all information to SCS shall be blocked via binary input or relay settings; | |  | |
| Second interface for connection to portable PC and communication software for: data exchange and parameterization of protection devices; readout and evaluation of fault reports and record disturbances; | |  | |
| Third interface for connection of those relays with disturbance recorder function. The communication software should be provided to read-out fault data and record disturbances. | |  | |
| Built-in real time clock with resolution of 1 ms, with external time synchronization inputs and using IEC61850; | |  | |
| Service value reading (three phase current and voltage, active and reactive power, frequency, power factor, internal time etc.); | |  | |
| Continuous hardware and software self-supervision with fault indication (fault code); | |  | |
| Possibility to read out and print all configurations and settings; | |  | |
| At least 10 programmable LED’s. LED indication for healthy state and internal fail state. After next pickup of protection device LED’s indication shall not be erased; | |  | |
| Supply voltage failures and relay restart cause no damage information of events (trip, pickup and fault current) and oscillograms. | |  | |

* 1. 330 kV lines

|  |  |  |
| --- | --- | --- |
| Description: | Required: | Offered: |
| Lines shall be protected and monitored with line differential and distance protection relays. | |  |
| Differential, overcurrent and earth fault protections stages in all digital relays shall be with the following features: | | See below |
| * Restriction during transformer inrush; | |  |
| * Second harmonics restraint function with settable level the ratio of second harmonics to fundamental harmonics; | |  |
| * Cross blocking between phases with second harmonic detection; | |  |
| The voltage supply for line 330 kV circuit breaker shall be:  separate DC voltage for the first tripping coil and for the second tripping coil + closing coil;  separate auxiliary voltage MCB’s for each coil; | |  |
| Two separate selector switches (one for each protection relay) for disconnecting transmitted and received commands and signals to and from line remote- end (one NC, six NO contacts, 0,2 A, 110 V DC) shall be installed. | |  |

* + 1. Telesignaling devices for transmission lines remote ends**.**

| Description: | Required: | Offered: |
| --- | --- | --- |
| Quantity | 4 pcs. |  |
| Ordering code |  | |
| Telesignalingequipment shall be designed to transmit 16 commands and receive 16 commands. | |  |
| Commands transmission time from binary input activation from transmitter to receiver binary output contact closing at line remote end ≤ **15** ms | |  |
| Communication interface for multimode optical communication. Wires for connection to the communication equipment shall be included. | 4 pcs. |  |
| Communication interface for direct optical communication. Line length indicated in single line diagram.  Wires for connection to the communication equipment shall be included. | 4 pcs. |  |
| Ethernet communication interface | |  |
| GOOSE signals | |  |
| Selector switches for disconnecting transmitted and received commands from and to line remote end (totally 16 NO contacts; 0,5 A; 220 V DC) shall be installed | |  |
| Event recorder; | |  |
| Trip value recorder; | |  |
| Disturbance recorder with not less than 10 s of total recording time; | |  |
| Extensive configuration possibilities by use of internal logical gates, timers and user configurable connection between different functions, binary inputs and outputs; | |  |
| Binary inputs and groups | ≥ 16 |  |
| Binary outputs and groups | ≥ 16 |  |

* + 1. Main protection for transmission lines**.**

| Description: | Required: | Offered: |
| --- | --- | --- |
| Quantity | 4 pcs |  |
| Spare line differential protection | 1 pc. |  |
| Ordering code for optical communication interface **(Informative part)** |  | |
| Communication interface for multimode optical communication. Wires for connection to the communication equipment shall be included. | 4 pcs. |  |
| Communication interface for direct optical communication. Line length indicated in single line diagram.  Wires for connection to the communication equipment shall be included. | 4 pcs. |  |
| Ordering code for line differential relay **(Informative part)** |  | |
| Current differential protection with both the current amplitude and phase angle measuring for each phase for **both** ends, with restrained and unrestrained differential protection stages, with differential current alarm with settable level | |  |
| Parallel line compensation for fault locator | |  |
| Transmission of information from 8 binary inputs via protection data interface. Information circuit to binary inputs shall be provided via disconnectable terminals | |  |
| Transfer trip function | |  |
| Four-stage directional definite time overcurrent protection with freely selected directionality settings for each stage: “forward”, “reverse”, “non-directional”; | |  |
| Any used overcurrent protection stage shall provide concurrent functionality for switch-onto-fault logic with instantaneous trip and freely selected blocking / not blocking from 2nd harmonic of the phase currents. Information about which overcurrent protection stage operates shall be sent to the SCS.  If the functionality mentioned is not possible, an additional overcurrent protection stage shall be provided; | |  |
| Four - stage directional definite time earth fault protection with freely selected directionality settings for each stage: “forward”, “reverse”, “non-directional”; | |  |
| Any used earth fault protection stage shall provide concurrent functionality for switch-onto-fault logic with instantaneous trip and freely selected blocking / not blocking from 2nd harmonic of the phase currents. Information about which earth fault protection stage operates shall be sent to the SCS.  If the functionality mentioned is not possible, an additional earth fault protection stage shall be provided. | |  |
| Single/three-phase tripping | |  |
| Automatic (as separate function) or possibility to made by configuration switch-onto-fault logic operating at closing of circuit breaker manually and from autorecloser. If fault occurs within user set time after closing of circuit breaker, user freely selected protection stage must operate instantaneously | |  |
| Fuse failure supervision function, which reacts on “3Uo without 3Io”; | |  |
| Current circuit supervision | |  |
| Fault locator, information shall be sent to SCS in metric units | |  |
| Event recorder | |  |
| Trip value recorder | |  |
| Disturbance recorder with not less than 10 s of total recording time, with recording of all analogue channels | |  |
| Four independent groups of setting parameters | |  |
| Extensive configuration possibilities by use of internal logical gates, timers and user configurable connection between different functions, binary inputs and outputs | |  |
| Analog current inputs for 330 kV side currents | 4 |  |
| Analog voltage inputs for three phases 330 kV side voltages | 3 |  |
| Analog voltage input for one phase 330 kV busbar voltage | 1 |  |
| Binary inputs and groups | ≥ 21 |  |
| Binary outputs and groups | ≥ 24 |  |
| Shall be installed test switch (for tripping, closing, start of CBF, currents and voltage circuits disconnection during maintenance) without auxiliary relays) including test handle or plug | |  |
| Ordering code for test switch (**Informative part**) |  | |

* + 1. Back-up protection for transmission lines **and main protection for CLIENT lines**.

| Description: | Required: | | Offered: |
| --- | --- | --- | --- |
| Quantity | 4 pcs. | |  |
| Spare line distance protection | 1 pc. | |  |
| Ordering code **(Informative part)** |  | | |
| Phase-to-phase and phase-to-ground distance protection with not less than **six** independently settable polygonal impedance measuring zones and freely settable directionality of not less than three zones | | |  |
| Possibility to cut the area of the load impedance out of the distance protection zones polygons with settable resistive reach and angle in forward and reverse directions | | |  |
| For each zone independently settable zero sequence reactance and resistance or earth return ratio | | |  |
| Parallel line compensation for fault locator and for distance protection at least for zone 1 and zone 2 | | |  |
| Any distance protection zone shall provide functionality for instantaneous operation by acceleration command from the remote line end. Information about which distance protection zone operates shall be sent to the SCS. | | |  |
| Any used distance protection zone shall provide concurrent functionality for switch-onto-fault logic with instantaneous trip and freely selected blocking / not blocking from 2nd harmonic of the phase currents. Information about which distance protection zone operates shall be sent to the SCS.  If the functionality mentioned is not possible, an additional distance protection zone shall be provided. | | |  |
| Current reversal logic for distance protection and for earth fault protection; | | |  |
| Week infeed for distance protection and for earth fault protection; | | |  |
| Four stage directional overcurrent protection with freely selected directionality settings for each stage: “forward”, “reverse”, “non-directional” | | |  |
| Any used overcurrent protection stage shall provide concurrent functionality for switch-onto-fault logic with instantaneous trip, **with voltage release** from definite time undervoltage protection and freely selected blocking / not blocking from 2nd harmonic of the phase currents. Information about which overcurrent protection stage operates shall be sent to the SCS.  If the functionality mentioned is not possible, an additional overcurrent protection stage shall be provided. | | |  |
| Broken conductor protection; | | |  |
| Four stage directional earth fault protection with freely selected directionality settings for each stage: “forward”, “reverse”, “non-directional” | | |  |
| If relay uses the earth fault directional element for instantaneous operation by acceleration command from the remote line end, then additional 5th earth fault protection directional stage is not required.  If relay uses earth fault protection directional stage for instantaneous operation by acceleration command from the remote line end, the relay shall have additional 5th earth fault protection directional stage which shall provide functionality.  Information about which earth fault protection stage operates by the command from the remote line end shall be sent to the SCS. | | |  |
| Any used earth fault protection stage shall provide concurrent functionality for switch-onto-fault logic with instantaneous trip and freely selected blocking / not blocking from 2nd harmonic of the phase currents. Information about which earth fault protection stage operates shall be sent to the SCS.  If the functionality mentioned is not possible, an additional protection stage shall be provided. | | |  |
| Power swing detection with possibility to block user freely selected distance protection zones | | |  |
| Directional two stages over power protection. Each stage shall be with freely selected active, reactive or apparent power settings | | |  |
| Directional two stages under power protection. Each stage shall be with freely selected active, reactive or apparent power settings | | |  |
| Three phase two stage definite time undervoltage protection with freely selected phases / phase-to-phase voltages for each stage separately, with freely selected "OR / AND" logic for selected voltages for each stage separately | | |  |
| Three phase two stage definite time overvoltage protection with freely selected phases / phase-to-phase voltages for each stage separately, with freely selected "OR / AND" logic for selected voltages for each stage separately | | |  |
| Single/three-phase tripping; | | |  |
| Scheme communication logic for distance protection (permissive and blocking scheme) | | |  |
| Scheme communication logic for earth fault protection (permissive and blocking scheme) | | |  |
| Automatic or made by configuration switch-onto-fault logic operating at closing of circuit breaker manually and from autorecloser. If fault occurs within user set time after closing of circuit breaker, user freely selected distance protection zones, overcurrent and earth fault protection stages must operate instantaneously. | | |  |
| Fuse failure supervision function, which reacts on “3Uo without 3Io” | | |  |
| Fuse failure supervision function, which reacts on “dU/dt without dI/dt” | | |  |
| Current circuit supervision | | |  |
| Four independent groups of setting parameters | | |  |
| Fault locator, information shall be sent to SCS in metric units | | |  |
| Event recorder | | |  |
| Trip value recorder | | |  |
| Disturbance recorder with not less than 10 s of total recording time, with recording of all analogue channels | | |  |
| Extensive configuration possibilities by use of internal logical gates, timers and user configurable connection between different functions, binary inputs and outputs | | |  |
| Analog current inputs for 330 kV side currents | | 4 |  |
| Analog voltage inputs for three phases 330 kV side voltages | | 3 |  |
| Analog voltage input for one phase 330 kV busbar voltage | | 1 |  |
| Binary inputs and groups | | ≥ 21 |  |
| Binary outputs and groups | | ≥ 24 |  |
| Shall be installed test switch (for tripping, closing, start of CBF, currents and voltage circuits disconnection during maintenance) without auxiliary relays) including test handle or plug | | |  |
| Ordering code for test switch (**Informative part**) | |  | |
| Setting group selection using the IEC 61850 communication protocol. | | |  |

1.2. 330kV transmission lines, bus-coupler and CLIENT line bay control modules.

| Description: | Required: | Offered: |
| --- | --- | --- |
| Bay control module shall be installed in the substation control room in protection cubicle of each particular bay according to single line diagram | 5 pcs. |  |
| Spare bay control module (including auto-reclosing) | 1 pc. |  |
| Ordering code **(Informative part)** |  | |
| Ordering code for trip circuit supervision relays |  | |
| Local/Remote button or key to block control commands from control system | |  |
| Single and three-phase auto-reclosing with functional logic with internal and external start and block (auto-reclosing function can be carried out in separate unit):   * three-phase trip→T2 time delay→close (if close onto fault, then next auto-reclosing stopped) * single-phase trip→T1 time delay→close to fault→trip three phases→T3 time delay→close (if close onto fault, then next auto-reclosing stopped) * single-phase trip→start T1 time delay and if during T1 is fault→trip three phases→T2 time delay→close (if close onto fault, then next auto-reclosing stopped)   remark: T1, T2, T3 are different times settings. | |  |
| Synchrocheck, voltage and synchronizing check for auto-reclosing of synchronous and asynchronous networks | |  |
| Manual closing of circuit breaker of synchronous and asynchronous networks with separate from auto-reclosing synchrocheck, voltage and synchonizing check settings (if not, then shall be delivered in separate unit / please indicate it in “Offered”) | |  |
| When manual closing is done should be indicated on local control PC and on SCADA measurements between synchronizing voltages: frequency difference (+/–), angle (+/–), voltages difference (+/–) | |  |
| Four stage directional overcurrent protection with freely selected directionality settings for each stage: “forward”, “reverse”, “non-directional” | |  |
| Four stage non-directional definite time overcurrent protection | |  |
| Any used overcurrent protection stage shall provide concurrent functionality for switch-onto-fault logic with instantaneous trip, **with voltage release** from definite time undervoltage protection and freely selected blocking / not blocking from 2nd harmonic of the phase currents. Information about which overcurrent protection stage operates shall be sent to the SCS.  If the functionality mentioned is not possible, an additional overcurrent protection stage shall be provided. | |  |
| Four stage directional earth fault protection with freely selected directionality settings for each stage: “forward”, “reverse”, “non-directional”. | |  |
| Four stage non-directional definite time earth fault protection. | |  |
| Any used earth fault protection stage shall provide concurrent functionality for switch-onto-fault logic with instantaneous trip and freely selected blocking / not blocking from 2nd harmonic of the phase currents. Information about which earth fault protection stage operates shall be sent to the SCS.  If the functionality mentioned is not possible, an additional protection stage shall be provided. | |  |
| Automatic or made by configuration switch-onto-fault logic operating at closing of circuit breaker manually and from autorecloser. If a fault occurs within the user settable time after closing of circuit breaker, user freely selected overcurrent and earth fault protection stages must operate instantaneously. | |  |
| Broken conductor protection | |  |
| Directional two stages over power protection. Each stage shall be with freely selected active, reactive or apparent power settings | |  |
| Directional two stages under power protection. Each stage shall be with freely selected active, reactive or apparent power settings | |  |
| Three phase two stage definite time undervoltage protection with freely selected phases / phase-to-phase voltages for each stage separately, with freely selected "OR / AND" logic for selected voltages for each stage separately | |  |
| Three phase two stage definite time overvoltage protection with freely selected phases / phase-to-phase voltages for each stage separately, with freely selected "OR / AND" logic for selected voltages for each stage separately | |  |
| For stage overfrequency/underfrequency with freely selected settings for each stage: “overfrequency”, “underfrequency”. | |  |
| Rate of change of frequency (ROCOF) protection. | |  |
| **Single/three phase tripping** | |  |
| Fuse failure supervision function, which reacts on “3Uo without 3Io”; | |  |
| Current circuit supervision | |  |
| Circuit breaker trip circuit supervision separately for both coils. For trip circuit supervision separate relays shall be used | |  |
| On/off control of all controllable switching devices at the respective bay | |  |
| The user defined characteristics of maximum permissible numbers of interruptions as a function of the braking current. Circuit breaker resource in percent (0 – 100%) shall be indicated on LCD | |  |
| LCD display which shows the single line diagram of the bay and the real-time state of the switching devices. It shall be possible for the Purchaser to modify the single line diagram in case if the bay configuration is changed | |  |
| Possibility to connect and configure using IEC 61850 protocol 10 binary inputs for connection to alarm system | |  |
| Three-phase P, Q, U and I measurements with directionality determination, with two P >, Q >, U >, I > setpoints and two P <, Q <, U <, I < setpoints. Each setpoint shall be configurable with timers (settings not less than 100s) and logic elements. Measurement functions can be used; | |  |
| Extensive configuration possibilities by use of internal logical gates, timers and user configurable connection between different functions, binary inputs and outputs | |  |
| Four independent groups of setting parameters | |  |
| Event recorder | |  |
| Disturbance recorder with not less than 10 s of total recording time, with recording of all analogue channels | |  |
| Analog current inputs for 330 kV side currents | 4 |  |
| Analog voltage inputs for three phases 330 kV side voltages | 3 |  |
| Analog voltage input for one phase 330 kV busbar voltage | 1 |  |
| Binary inputs | ≥ 55 |  |
| Binary inputs groups | ≥ 12 |  |
| Binary outputs | ≥ 35 |  |
| Binary output groups | ≥ 31 |  |
| Interlocking of the bays shall be done in bay control modules and including following functionality: | |  |
| At least 8 separate outputs to block control function of disconnectors and earth switches with motor drive in the switchgear | |  |
| At least 6 separate inputs to use state conditions from the other equipment of the substation | |  |
| Interlocking logic shall be approved by the Customer | |  |
| Setting group selection using the IEC 61850 communication protocol. | |  |

1.3. 330 kV busbar protection and breaker failure protection.

| Description: | Required: | | Offered: |
| --- | --- | --- | --- |
| Quantity | 1 set | |  |
| Ordering code **(Informative part)** |  | | |
| Quantity of test plugs | 7 pcs | |  |
| Ordering code of test plug **(Informative part)** |  | | |
| Breaker failure protection shall be implemented in busbar protection terminal (terminals); | | |  |
| Protection shall be low impedance numerical protection designed to trip separately each of the two busbars, with **two** extra bays (7 bays). Wiring shall be included; | | |  |
| Check zone; | | |  |
| End protection of bays; | | |  |
| Separate outputs for busbar protection trip; | | |  |
| Separate outputs of breaker failure protection re-trip and back-trip for each circuit-breaker | | |  |
| Automatic bay current measurement excluding from software in case if bay’s disconnector is opened; | | |  |
| Selector switch for switching on/off operation of busbar and circuit breaker protections; | | |  |
| Event recorder; | | |  |
| Disturbance recorder with not less than 5 s of recording time; | | |  |
| Test handles shall be installed to disconnect tripping and currents circuits during maintenance without auxiliary relays, including test switch or plug; | | |  |
| **Busbar protection**: | | |  |
| Three-phase trip; | | |  |
| The busbar protection shall have check zone and shall be able to supervise isolators auxiliary contacts using the logic “Not CLOSED = OPENED”; | | |  |
| Stability for all external faults; | | |  |
| Detection of any external fault and CT saturation shall not affect the ability or time to detect an internal fault; | | |  |
| Lacking protection function to cover a part of the busbar due to CT arrangement; | | |  |
| Open current transformer’s circuit alarm; | | |  |
| Application with separate measuring for each phase; | | |  |
| **Circuit-breaker failure protection**: | | |  |
| Current check function for each phase; | | |  |
| Single/three-phase retrip and three-phase back-up trip; | | |  |
| To have accurate, consistent, short operating times and high overload capacity; | | |  |
| Transfer trip to faulty line remote end. | | |  |
| Binary inputs for each of 330 kV bays | | ≥ 12 |  |
| Binary outputs and groups for each of 330 kV bays | | ≥ 8 |  |

**1.4. Emergency automatic control module.**

|  |  |  |  |
| --- | --- | --- | --- |
| Description: | Required: | | Offered: |
| Quantity | 2 pcs | |  |
| Ordering code (informative part) |  | | |
| Time from binary input activation to binary output closing, when slowest resource for logic is used not more than **40ms** | | |  |
| Extensive configuration possibilities by use of internal logical gates, timers and user configurable connection between different functions, binary inputs and outputs | | |  |
| LCD display which shows the single line diagram of the bay and the real-time state of the switching devices. It shall be possible for the Purchaser to modify the single line diagram in case the bay configuration is changed; | | |  |
| Event recorder | | |  |
| Disturbance recorder with not less than 20 s of total recording time. | | |  |
| The logic shall not be affected by auxiliary supply lose or logic device restart | | |  |
| **Information exchange with delivered relay protection using the IEC 61850 communication protocol.** | | |  |
| Logical timers | | ≥ 100 |  |
| Logical pulse timers | | ≥ 100 |  |
| Virtual inputs | | ≥ 250 |  |
| Virtual outputs | | ≥ 100 |  |
| Digital inputs | | ≥ 16 |  |
| Digital outputs | | ≥ 16 |  |

1.5. Training for delivered relay protection equipment.

|  |  |  |
| --- | --- | --- |
| Description | | See below |
| Following training for 2 engineers in the factory intelligence center or laboratory: | |  |
| * Days for training | Please indicate |  |
| * Name of intelligence center | Please indicate |  |
| * Line distance protection | |  |
| * Line differential protection | |  |
| * Busbar and breaker protection | |  |
| * Relay protection with IEC61850 | |  |
| The training should be finished at least one month before commissioning works on site. | |  |
| The training should be performed on the equipment and software provided for delivery or identical | |  |
| After the successful training it should be acknowledged with the issuance of appropriate certificate to the trained personnel | |  |

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