



ISO/IEC 14543-4-302

Edition 1.0 2023-04

INTERNATIONAL STANDARD



**Information technology – Home electronic system (HES) architecture –
Part 4-302: Application protocols for electrical storage systems and controllers**

IECNORM.COM : Click to view the full PDF of ISO/IEC 14543-4-302:2023



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2023 ISO/IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about ISO/IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IECNORM.COM : Click to view the full PDF of IEC 60342-02:2023



ISO/IEC 14543-4-302

Edition 1.0 2023-04

INTERNATIONAL STANDARD



**Information technology – Home electronic system (HES) architecture –
Part 4-302: Application protocols for electrical storage systems and controllers**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 35.240.67

ISBN 978-2-8322-6793-6

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references	8
3 Terms, definitions and abbreviated terms	8
3.1 Terms and definitions.....	8
3.2 Abbreviations	9
4 Conformance	10
5 Configuration.....	10
5.1 General.....	10
5.2 Configuration and components.....	10
5.3 Connection configuration	11
6 Application layer	12
6.1 General.....	12
6.2 NECD objects	12
6.3 NECD services.....	12
6.4 Object-specific NECD properties.....	12
6.5 Application operation	14
6.5.1 General	14
6.5.2 Continuous requests	14
6.5.3 Response wait time value for controllers.....	15
6.5.4 Resending a frame	15
6.5.5 Processing object property counter.....	15
6.5.6 Property values of write requests.....	15
7 Normal operation	16
7.1 General.....	16
7.2 Start-up operation.....	18
7.2.1 General	18
7.2.2 Start-up processing of NECD nodes	18
7.2.3 Search processing	18
7.2.4 Obtaining NECD attribute information	18
7.2.5 Obtaining electrical storage system attribute information	19
7.3 Occasional operation	22
7.3.1 General	22
7.3.2 Obtaining electrical storage system status	22
7.3.3 Setting and updating "AC charge amount target value" property (or "AC discharge amount target value" property).....	25
7.3.4 Setting and updating "Charging electric power setting" property (or "Discharging electric power setting" property) (optional)	28
7.3.5 Setting "Charging method" property (or "Discharging method" property) (optional)	31
7.3.6 Setting "Operation mode setting" property	34
7.3.7 Terminating charging (or discharging) operation of the storage battery based on "AC charging amount target value" property (or "AC discharging amount target value" property).....	37
7.4 Fault status notification	41
8 Remote control	42

8.1	General.....	42
8.2	Setting and updating "AC charge amount target value" property (or "AC discharge amount target value" property) on remote control.....	42
8.3	Setting "Operation mode setting" property when remotely controlling	44
9	Considerations on controllers	46
9.1	General.....	46
9.2	Restrictions by electrical storage system implementations	47
Annex A (informative) Terms and NECD protocol frame format on ISO/IEC 14543-4-3 and IEC 62394		48
A.1	Terms correspondence between ISO/IEC 14543-4-3 and IEC 62394	48
A.2	NECD protocol frame format	48
Annex B (informative) Relationship between ISO/IEC 14543-4 series and the HES gateway, based on ISO/IEC 15045 series and ISO/IEC 18012 series		50
Bibliography.....		51
Figure 1 – Relationship between IEC 62394, ISO/IEC 14543-4-3 and ISO/IEC 14543-4-302.....		7
Figure 2 – Example of electrical storage system configuration and components.....		10
Figure 3 – Connection configurations		11
Figure 4 – Assumed network stack.....		11
Figure 5 – Summary of normal operation sequences.....		17
Figure 6 – Sequence for obtaining NECD attribute information.....		19
Figure 7 – Sequence of obtaining electrical storage system attribute information		21
Figure 8 – Sequence to obtain status of electrical storage systems.....		25
Figure 9 – Sequence for setting "AC charge amount target value" property (or "AC discharge amount target value" property).....		28
Figure 10 – Sequence for setting "Charging electric power setting" property (or "Discharging electric power setting" property).....		31
Figure 11 – Sequence for setting "Charging method" property (or "Discharging method" property).....		33
Figure 12 – Sequence for setting "Charging method" property (or "Discharging method" property) when no response is received from the storage battery.....		34
Figure 13 – Sequence for setting "Operation mode setting" property.....		36
Figure 14 – Sequence for setting "Operation mode setting" property when no response is received from the storage battery		37
Figure 15 – Sequence of terminating charging (discharging) operation based on "AC charge amount target value" property ("AC discharge amount target value" property)		40
Figure 16 – Sequence of terminating charge (discharge) operation based on "AC charge amount target value" property ("AC discharge amount target value" property) when "Operation mode setting" property is changed		41
Figure 17 – Remote control.....		42
Figure 18 – Example of setting sequence for "AC charge amount target value" property ("AC discharge amount target value" property) when "Remote control setting" property is used.....		44
Figure 19 – Example of setting sequence for "Operation mode setting" property when "Remote control setting" property is used.....		45
Figure 20 – Example of setting sequence for "Operation mode setting" property when "Remote control setting" property is used, in case that no response is made by electrical storage system		46

Figure A.1 – NECD protocol frame format	49
Table 1 – NECD objects.....	12
Table 2 – NECD services	12
Table 3 – NECD properties of device object (super class).....	13
Table 4 – NECD properties of device object.....	13
Table 5 – Response wait time values for controllers.....	15
Table 6 – Re-set wait time for the AC charge (or discharge) amount target value.....	27
Table 7 – Wait time for re-setting charging and discharging electric power setting	30
Table 8 – Wait time for charging and discharging method for re-setting	32
Table 9 – Wait time for re-setting operation mode	35
Table A.1 – Terms correspondence table between ISO/IEC 14543-4-3 and IEC 62394	48
Table B.1 – Partial list of the translation between ISO/IEC 14543-4-302 and HES gateway lexicon (ISO/IEC 18012-3)	50

IECNORM.COM : Click to view the full PDF of ISO/IEC 14543-4-302:2023

INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) ARCHITECTURE –

Part 4-302: Application protocols for electrical storage systems and controllers

FOREWORD

- 1) ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.
- 2) The formal decisions or agreements of IEC and ISO on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC and ISO National bodies.
- 3) IEC and ISO documents have the form of recommendations for international use and are accepted by IEC and ISO National bodies in that sense. While all reasonable efforts are made to ensure that the technical content of IEC and ISO documents is accurate, IEC and ISO cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC and ISO National bodies undertake to apply IEC and ISO documents transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC and ISO document and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC and ISO do not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC and ISO marks of conformity. IEC and ISO are not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this document.
- 7) No liability shall attach to IEC and ISO or their directors, employees, servants or agents including individual experts and members of its technical committees and IEC and ISO National bodies for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this ISO/IEC document or any other IEC and ISO documents.
- 8) Attention is drawn to the Normative references cited in this document. Use of the referenced publications is indispensable for the correct application of this document.
- 9) Attention is drawn to the possibility that some of the elements of this ISO/IEC document may be the subject of patent rights. IEC and ISO shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 14543-4-302 has been prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology. It is an International Standard.

The list of all currently available parts of the ISO/IEC 14543 series, under the general title *Information technology – Home Electronic System (HES) architecture*, can be found on the IEC website and ISO website.

The text of this International Standard is based on the following documents:

Draft	Report on voting
JTC1-SC25/3100/CDV	JTC1-SC25/3130/RVC

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1, available at www.iec.ch/members_experts/refdocs and www.iso.org/directives.

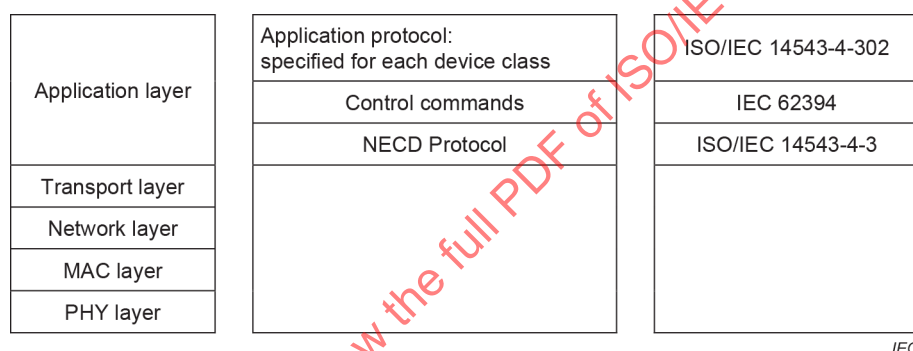
IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

IECNORM.COM : Click to view the full PDF of ISO/IEC 14543-4-302:2023

INTRODUCTION

This part of ISO/IEC 14543 specifies the detailed procedures and behaviours of both electrical storage systems and controllers at the application level of communications based on ISO/IEC 14543-4-3. This document specifies the message structure, sequences and protocol of the application layer for networked enhanced control devices used in the Home Electronic System (HES). Some services are targeted for communications between devices. Other services are exclusively reserved for management purposes. Some services can be used for both management and run-time communications. This document is applicable for energy management services involving storage batteries, inverters, chargers and related devices.

Figure 1 shows the relationship among IEC 62394, ISO/IEC 14543-4-3 and ISO/IEC 14543-4-302. ISO/IEC 14543-4-3 specifies the message structure, sequences and protocol for general-purpose communications used in network enhanced control devices of the Home Electronic System (HES) Class 1. ISO/IEC 14543-4-3 provides the common interfaces for the use-level process and the services such as energy management, remote maintenance, and other services for easily building a system consisting of multi-vendor devices and equipment. IEC 62394 specifies the detailed lists of control commands on NECD objects (see ISO/IEC 14543-4-3). Annex A shows terms and NECD protocol frame format on ISO/IEC 14543-4-3 and IEC 62394.



IEC

Figure 1 – Relationship between IEC 62394, ISO/IEC 14543-4-3 and ISO/IEC 14543-4-302

ISO/IEC 14543-4-3 is a general-purpose communications specification that applies to a variety of devices. ISO/IEC 14543-4-3 is the basis for this document, which specifies detailed procedures and behaviours for pre-packaged system solutions that include storage batteries, inverters, chargers and related devices. The procedures and behaviours specified in this document can be used for energy flow inside a home or energy flow between the grid and a home.

In order to enhance interoperability, it is important to specify how to implement ISO/IEC 14543-4-3 for each device and controller at the application level such as command sequences, timeout requirements, required combinations of acceptable commands, etc..

INFORMATION TECHNOLOGY – HOME ELECTRONIC SYSTEM (HES) ARCHITECTURE –

Part 4-302: Application protocols for electrical storage systems and controllers

1 Scope

This part of ISO/IEC 14543 specifies an application-layer protocol important for ensuring interoperability among the products of various manufacturers regarding communications between electrical storage systems and controllers. It uses the network enhanced communications device (NECD) protocol specified in ISO/IEC 14543-4-3. This protocol is based on UDP using IPv4 or IPv6 (TCP is optional).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 14543-4-3, *Information technology – Home Electronic System (HES) architecture – Part 4-3: Application layer interface to lower communications layers for network enhanced control devices of HES Class 1*

IEC 62394, *Service diagnostic interface for consumer electronics products and networks – Implementation for ECHONET*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1.1

battery management unit

BMU

device that manages packs and cells

Note 1 to entry: Examples of management functions: monitoring state, calculating, checking environment, balancing, etc.

3.1.2

cell

device that can be charged and discharged repeatedly

Note 1 to entry: The typical residential device is a lithium ion battery.

3.1.3

device object

network enhanced control device (NECD) object other than a node profile object

Note 1 to entry: In this document, "device object" refers to storage battery object only.

3.1.4

electrical storage system

combination of devices that include single or multiple power conditioning systems (PCSs), battery management units (BMUs), and packs to support primarily residential applications, including a communications interface

3.1.5

NECD protocol

protocol used in network enhanced control device (NECD) communications

3.1.6

node profile

description of objects implemented in each node

3.1.7

pack

combination of cells

3.1.8

power conditioning system

PCS

device that charges and discharges cells, and translates DC voltage of cells to AC voltage (e.g. inverter), and AC voltage to DC voltage (e.g. charger) of cells

3.1.9

remote control

control from outside the home

3.1.10

response wait time

time between a controller request to and the response from an electrical storage system

3.1.11

super class

properties that are inherited and implemented in all device objects

3.2 Abbreviations

BMU	battery management unit
DNOJ	destination NECD object
IP	internet protocol
NDA	NECD data
NDT	NECD property value data
NECD	network enhanced control device
NHD	NECD header
NPC	NECD property code
NSV	NECD service
OPC	processing object property counter
PCS	power conditioning system

PDC	property data counter
SNOJ	source NECD object
TID	transaction ID
UDP	user datagram protocol

4 Conformance

Electrical storage systems and controllers of HES Class 1 that claim conformance to this document shall:

- send, receive and process sequences and procedures as specified in Clause 7.
- provide application services and properties specified in 6.2, 6.3 and 6.4 as needed by electrical storage systems and controllers for which the application is intended.

5 Configuration

5.1 General

Clause 5 specifies the configuration and components of an electrical storage system, and connection configurations between an electrical storage system and a controller.

5.2 Configuration and components

Figure 2 shows an example of an electrical storage system configuration and components. An electrical storage system basically includes the device or function of a power conditioning system (PCS), a battery management unit (BMU), and one or more packs. The electrical storage system includes the ISO/IEC 14543-4-302 data communications function on the PCS or BMU in many cases.

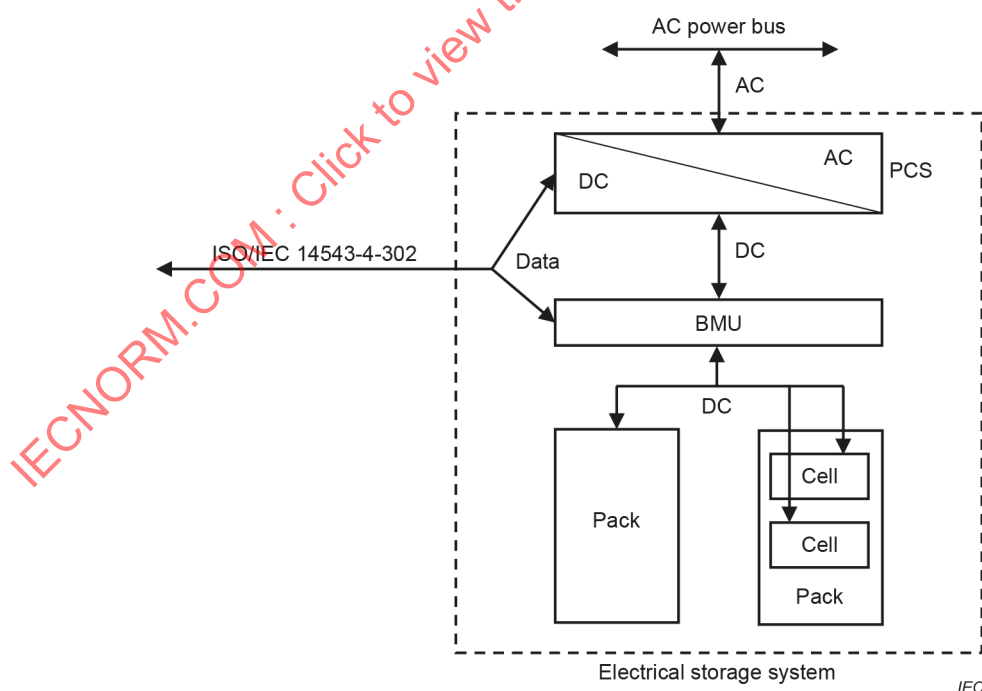
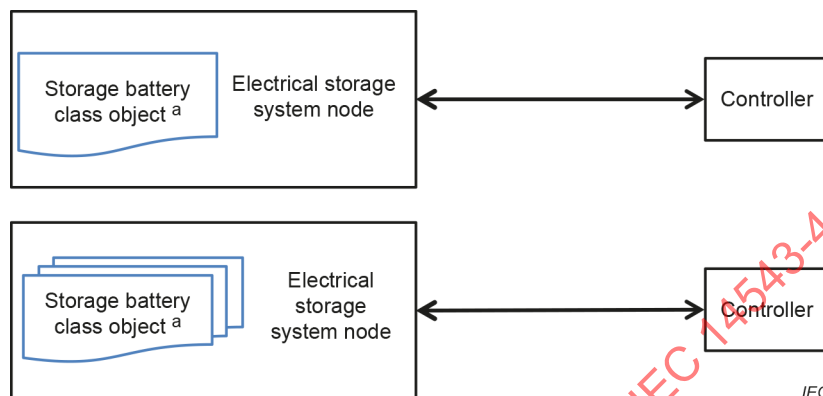


Figure 2 – Example of electrical storage system configuration and components

5.3 Connection configuration

This specification is necessary for ensuring interoperability between the products of different manufacturers in connection with application communications between electrical storage systems and controllers, using the NECD protocol as an application protocol via UDP (TCP)/IPv6 communications.

Figure 3 shows the configurations assumed under this specification.



^a "Storage battery class object" is a device object specified in IEC 62394.

Figure 3 – Connection configurations

The upper illustration in Figure 3 shows the case where a single device object is installed in a single node. The lower illustration shows the case where multiple device objects are installed in a single node. The latter case occurs when multiple battery units are attached to a single communications unit. In this case, there are multiple storage battery class objects in a single electrical storage system node (i.e. at a single IP address). Controllers shall support nodes that configure multiple device objects in a single node.

Controllers shall be capable of handling multiple nodes and objects. The maximum number of nodes and objects to be handled is implementation-dependent on the controllers. When multiple controllers are connected to a single system, some electrical storage systems cannot accept a request from a controller for a certain period of time after the electrical storage system received a request from another controller.

Figure 4 shows the assumed network stack for operating the NECD protocol in this document. NECD protocol operation is assumed as an application protocol on UDP(TCP)/IPv6. Note that TCP installation is optional. As a rule, the stack uses IPv6; however, IPv4 is allowed depending on the market trends for migration from IPv4 to IPv6.

Application layer		ISO/IEC 14543-4-302 IEC 62394 ISO/IEC 14543-4-3
Transport layer		UDP(TCP)
Network layer		IPv6 or IPv4
(Adaptation layer)		(6LoWPAN ^a)
MAC layer		(No specific MAC layer assumed)
PHY layer		(No specific PHY layer assumed)

^a Depends on transmission media using IPv6.

Figure 4 – Assumed network stack

Connection processing specific to each lower layer communications medium that is necessary in advance of the start of NECD communications is out of the scope of this document. In this document, application communications using the NECD protocol are specified on the assumption that connection processing specific to those communications media is complete.

6 Application layer

6.1 General

The NECD protocol shall be used at the application layer. All nodes that conform to this document shall support all mandatory functions specified in ISO/IEC 14543-4-3.

6.2 NECD objects

Electrical storage systems and controllers shall have the NECD objects shown in Table 1.

Table 1 – NECD objects

NECD object	Class group code	Class code	Class name	Instance code
Electrical storage system	0x02	0x7D	Storage battery	0x01 to 0x7F
	0x0E	0xF0	Node profile	0x01
Controller	0x05	0xFF	Controller	0x01 to 0x7F
	0x0E	0xF0	Node profile	0x01

NOTE Instance code 0x00 is designated to specify all instances of the same class in a node.

6.3 NECD services

Electrical storage systems and controllers shall support the NECD services shown in Table 2.

Table 2 – NECD services

NSV code	NECD service content	Symbol
0x51	Property value write "response-not-possible" response	SetC_SNA
0x52	Property value read "response-not-possible" response	Get_SNA
0x61	Property value write request (response required)	SetC
0x62	Property value read request	Get
0x71	Property value write response	Set_Res
0x72	Property value read response	Get_Res
0x73	Property value notification	INF

NOTE NSV codes which are specified in ISO/IEC 14543-4-3 but are not shown in Table 2 (0x60, 0x63, 0x6E, 0x74, 0x7A, 0x7E, 0x50, 0x53, and 0x5E) are not subject to the certification tests based on this document.

6.4 Object-specific NECD properties

Electrical storage systems shall install the NECD properties of a device object shown in Table 3 and Table 4. NECD properties of a node profile object shall support at least the mandatory properties.

Controllers shall send requests to the device object properties shown in Table 3 and Table 4. If a controller can control electrical storage systems via a public network, the remote control operations that set properties of storage batteries shall include SetC [0x61] to "Remote control setting" property [0x93].

Table 3 – NECD properties of device object (super class)

Property name	NPC	Units	Access rule		Announcement at status change	Remarks
			Get	Set		
Installation location	0x81	—	M	M	M	
Standard version information	0x82	—	M	—	—	
Fault status	0x88	—	M	—	M	
Manufacturer code	0x8A	—	M	—	—	
Remote control setting	0x93	—	O	O	—	
Status change announcement property map	0x9D	—	M	—	—	
Set property map	0x9E	—	M	—	—	
Get property map	0x9F	—	M	—	—	
M: mandatory, O: optional, —: not supported						

Table 4 – NECD properties of device object

Property name	NPC	Units	Access rule		Announcement at status change	Remarks
			Get	Set		
Operation status	0x80	—	M	—	M	
Identification number	0x83	—	M	—	—	
Current time setting	0x97	—	M	—	—	
Current date setting	0x98	—	M	—	—	
AC effective capacity (charging)	0xA0	Wh	M	—	—	AC
AC effective capacity (discharging)	0xA1	Wh	M	—	—	AC
AC chargeable capacity	0xA2	Wh	M	—	—	AC
AC dischargeable capacity	0xA3	Wh	M	—	—	AC
AC chargeable electric energy	0xA4	Wh	M	—	—	AC
AC dischargeable electric energy	0xA5	Wh	M	—	—	AC
AC cumulative charging electric energy	0xA8	0,001 kWh	M	—	—	AC
AC cumulative discharging electric energy	0xA9	0,001 kWh	M	—	—	AC
AC charge amount target value	0xAA	Wh	M	M	M	AC
AC discharge amount target value	0xAB	Wh	M	M	M	AC
Charging method	0xC1	—	M	O	M	
Discharging method	0xC2	—	M	O	M	
Minimum and maximum charging electric power	0xC8	W	M	—	—	AC
Minimum and maximum discharging electric power	0xC9	W	M	—	—	AC
Working operation status	0xCF	—	M	—	M	a, b

Property name	NPC	Units	Access rule		Announcement at status change	Remarks
			Get	Set		
Operation mode setting	0xDA	—	M	M	M	a, b
System-interconnected type	0xDB	—	M	—	—	
Remaining stored electricity 1	0xE2	Wh	M	—	—	DC ^c
Remaining stored electricity 2	0xE3	0,1 Ah	M	—	—	DC ^c
Remaining stored electricity 3	0xE4	%	M	—	—	^c
Battery type	0xE6	—	M	—	—	
Rated electric energy	0xD0	Wh	O	—	—	DC
Rated capacity	0xD1	0,1 Ah	O	—	—	DC
Rated voltage	0xD2	V	O	—	—	DC
Instantaneous charging and discharging electric power	0xD3	W	O	—	—	AC
Charging electric power setting	0xEB	W	O	O	—	AC
Discharging electric power setting	0xEC	W	O	O	—	AC
M: mandatory, O: optional, —: not supported						
^a Property values of "Charging", "Discharging", and "Standby" are mandatory. ^b When "Operation mode setting" property [0xDA] is set as "Auto", the property value of "Working operation status" property [0xCF] should be set as "Charging", "Discharging", or "Standby", depending on the actual status of the storage battery. ^c One of them is mandatory.						

The details of the properties shown in Table 3 and Table 4 are specified in IEC 62394 "Storage battery class specifications". If a discrepancy between IEC 62394 and this document exists, the description in this document applies.

Electrical storage systems may not operate as set on "Operation mode setting" property [0xDA] depending on the system status of the electrical storage system. The actual status of the electrical storage system (charging or discharging, etc.) should be set on "Working operation status" property [0xCF] and the value of "Operation mode setting" property [0xDA] should not be changed in this case.

Fault status of electrical storage systems shall be shown when using the standardized "Fault status" property [0x88]. Electrical storage systems may describe details of the fault status by using other fault NECD properties ("Manufacturer's fault code" property [0x86] and "Fault description" property [0x89]) as specified in IEC 62394.

6.5 Application operation

6.5.1 General

Subclauses 6.5.2 to 6.5.6 specify the operations on electrical storage systems and controllers at the application level.

6.5.2 Continuous requests

A request from a controller and the corresponding response from an electrical storage system is a basic unit of communications, i.e. an electrical storage system returns a single response to a single request. Controllers that issue continuous requests to an electrical storage system shall be designed with a response wait time defined in Table 5. When receiving a response, the time is reset and the controller can send a new request.

If a controller resends or continuously sends requests in an interval shorter than a response wait time value specified in Table 5, electrical storage systems may not accept the requests, may not renew the values to respond, or may not be able to renew the values correctly. Note that the "continuous requests" means continued requests to the same instance in the same electrical storage system node.

6.5.3 Response wait time value for controllers

The values of response wait times, which count the time from a controller's request until the response from the targeted electrical storage system, are specified in Table 5.

Table 5 – Response wait time values for controllers

Parameter name	Value	Remarks
Response wait time 1	At least 5 [s]	For SetC
Response wait time 2	At least 20 [s]	For Get

Note that electrical storage systems shall respond within the time specified in Table 5, in case the received request's OPC is 1 or in case the electrical storage system processes operations specified in Clause 7 only. In case the request's DNOJ instance code is all-instance designation code [0x00], the targeted electrical storage system shall return the first response frame within the time specified in Table 5.

6.5.4 Resending a frame

If a controller sends a request to an electrical storage system and does not receive the response from the electrical storage system within the response wait time value specified in Table 5, the frame shall not be retransmitted in a frame of the same TID. In this case controllers may resend a message with a different TID.

6.5.5 Processing object property counter

Electrical storage systems shall be capable of supporting OPC value of 11 or more. Electrical storage systems shall process operations with an OPC value of 11 as specified in Clause 7 only. Electrical storage systems may not process operations with any combination of NPCs up to 11.

The order of NPCs of the response to a request with multiple NPCs shall be the same as the request. Controllers shall support receiving INF [0x73] with multiple NPCs.

6.5.6 Property values of write requests

When controllers issue a SetC [0x61] request, a value outside the range of properties required by IEC 62394 shall not be set.

Electrical storage systems shall send SetC_SNA [0x51] when receiving the request SetC [0x61] from the controllers to properties indicating functions, if the setting values are those not installed on the actual devices. When the setting values are installed on the actual devices, Set_Res [0x71] shall be basically sent as an acceptance response. However, SetC_SNA [0x51] may be sent if there is no response to a set value during specific operations such as autonomous operation or maintenance mode.

Electrical storage systems should send Set_Res [0x71] as an acceptance response, after setting a value rounded to the highest or lowest value of the value range installed on the actual devices as a property value, when receiving SetC [0x61] request from controllers to properties indicating a continued value, if the set value is within the defined range of IEC 62394. When the setting values are within the range of values installed on the actual devices, Set_Res [0x71] shall be sent as an acceptance response.

If other requests are received within a specified time after receiving a request, electrical storage systems may not always send a response, depending on the process execution status of the devices.

Responses from electrical storage systems are acceptance responses. Therefore, controllers should check electrical storage system status after a specified period of time, even when receiving Set_Res [0x71], using announcement at status change from electrical storage systems or a Get [0x62] request to electrical storage systems.

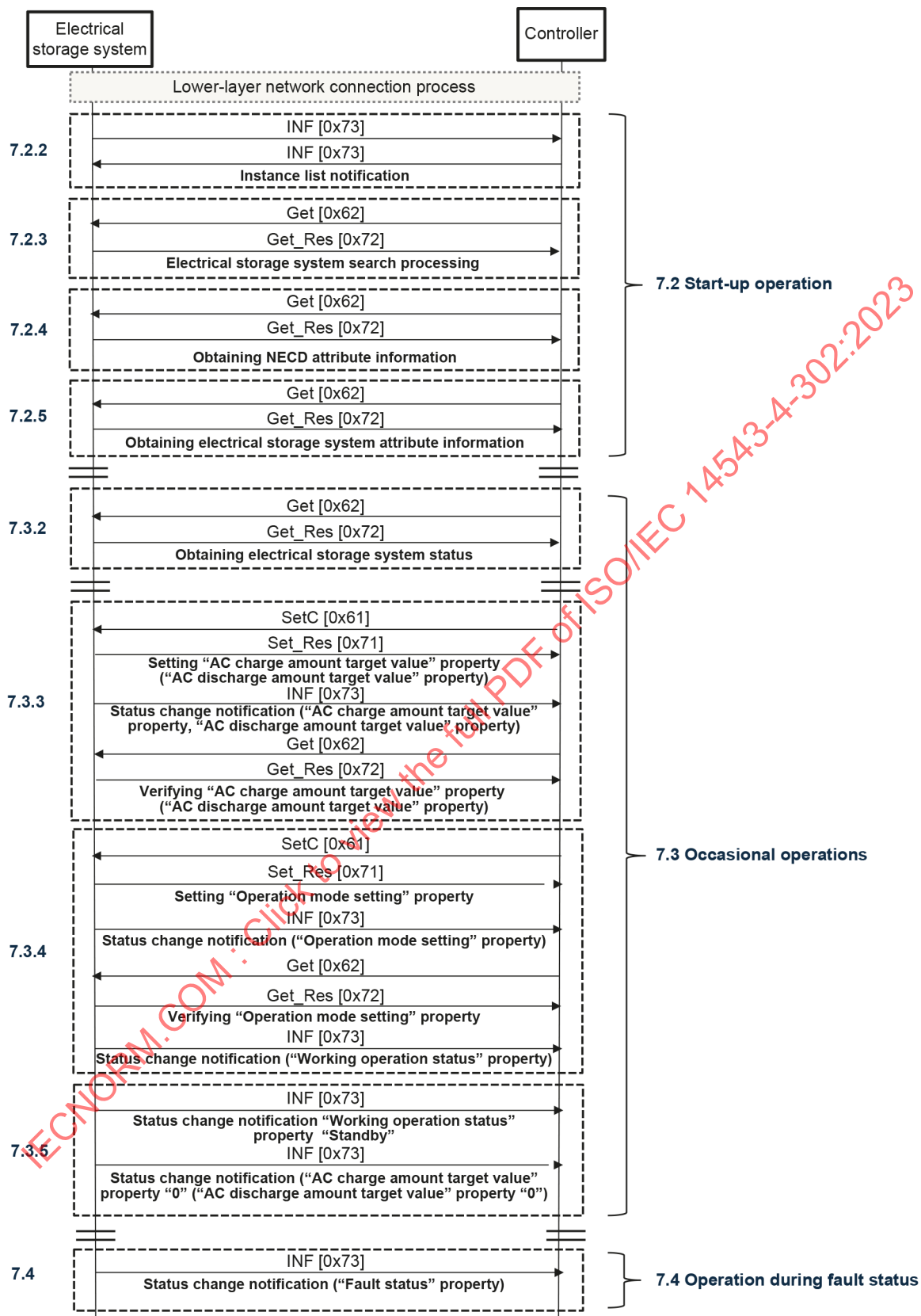
7 Normal operation

7.1 General

Clause 7 specifies the normal operation sequence between electrical storage systems and controllers.

Figure 5 shows the summary of normal operation sequences between an electrical storage system and a controller. Here, the connection process of the lower-layer network between electrical storage system and controller is assumed completed.

IECNORM.COM : Click to view the full PDF of ISO/IEC 14543-4-302:2023



IEC

Figure 5 – Summary of normal operation sequences

7.2 Start-up operation

7.2.1 General

Subclauses 7.2.2 to 7.2.5 specify the operations on electrical storage systems and controllers at start-up.

7.2.2 Start-up processing of NECD nodes

After establishing a connection to a lower-layer network, electrical storage systems and controllers notify each instance list.

Instance list notification may include:

- a) one node and one instance;
- b) one node and multiple instances of a class;
- c) one node and instances of multiple different classes.

In any case, controllers shall be able to recognize the devices to be managed upon receiving an instance list notification.

1) Target property of node profile object

- 0xD5: Instance list notification

7.2.3 Search processing

Controllers shall have a process to search electrical storage systems in preparation for cases where controllers fail to receive the instance list notifications sent from electrical storage systems at start-up. Controllers shall send Get [0x62] via multicast with DNOJ as storage battery object, with all-instance designation code [0x00], and with "Operation status" property [0x80]. Alternatively, controllers may send Get [0x62] via multicast with DNOJ as node profile object [0x0EF001] and its "Self-node instance list S" property [0xD6].

1) Target property of storage battery object

- 0x80: Operation status

7.2.4 Obtaining NECD attribute information

After receiving instance list notifications from electrical storage systems or after completing a search for electrical storage systems, controllers request NECD attribute information necessary for NECD communications. Controllers may re-obtain the NECD attribute information if necessary.

Controllers should confirm "Standard version information" property [0x82] and properties installed on the electrical storage systems based on the NECD attribute information, and then should issue requests to the installed properties.

1) Target properties of storage battery object

- 0x82: Standard version information
- 0x9D: Status change announcement property map
- 0x9E: Set property map
- 0x9F: Get property map

2) Sequence

Figure 6 shows the sequence for obtaining NECD attribute information.

- a) Controller requests four target properties (in any combination or in any order) by Get [0x62], after receiving an instance list notification from the target electrical storage system.

- b) The electrical storage system shall return Get_Res [0x72].

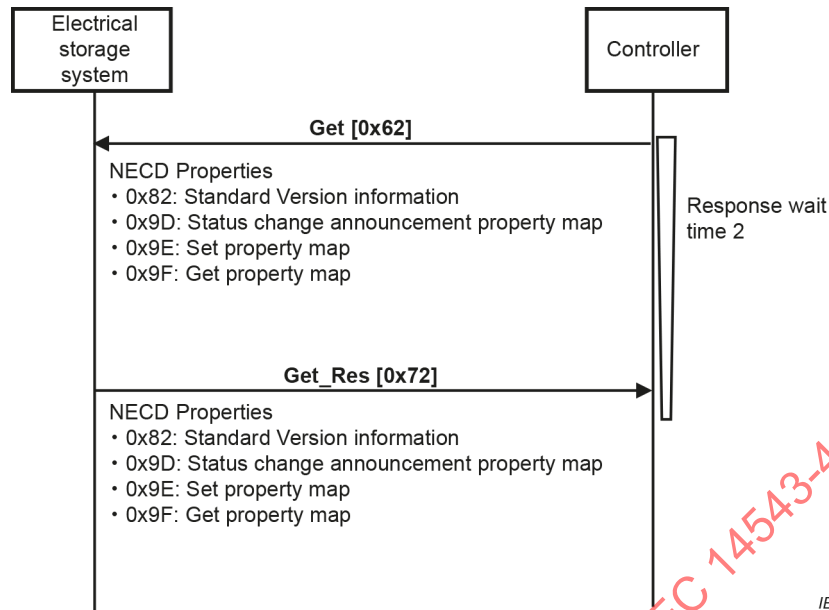


Figure 6 – Sequence for obtaining NECD attribute information

7.2.5 Obtaining electrical storage system attribute information

After receiving NECD attribute information from electrical storage systems, controllers request attribute information, etc. from electrical storage systems. Controllers may re-obtain the electrical storage system attribute information if necessary.

1) Target properties of storage battery object

a) Group1

- 0x80: Operation status
- 0x88: Fault status
- 0x8A: Manufacturer code
- 0xCF: Working operation status
- 0xD0: Rated electric energy [optional]
- 0xD1: Rated capacity [optional]
- 0xD2: Rated voltage [optional]
- 0xE2: Remaining stored electricity 1*
- 0xE3: Remaining stored electricity 2*
- 0xE4: Remaining stored electricity 3*
- 0xE6: Battery type

* One of the three shall be installed.

b) Group2

- 0x83: Identification number
- 0x97: Current time setting
- 0x98: Current date setting
- 0xA0: AC effective capacity (charging)
- 0xA1: AC effective capacity (discharging)
- 0xA2: AC chargeable capacity

- 0xA3: AC dischargeable capacity
- 0xC1: Charging method
- 0xC2: Discharging method
- 0xC8: Minimum and maximum charging electric power
- 0xC9: Minimum and maximum discharging electric power

2) Sequence

Figure 7 shows the sequence for obtaining electrical storage system attribute information.

- a) Controllers request the target properties (in any combination or in any order) by Get [0x62], after receiving NECD attribute information from the target electrical storage system.
- b) Electrical storage systems shall return the requested property values with Get_Res [0x72]. Electrical storage systems return Get_SNA [0x52] if a not-installed option property is requested.

IECNORM.COM : Click to view the full PDF of ISO/IEC 14543-4-302:2023

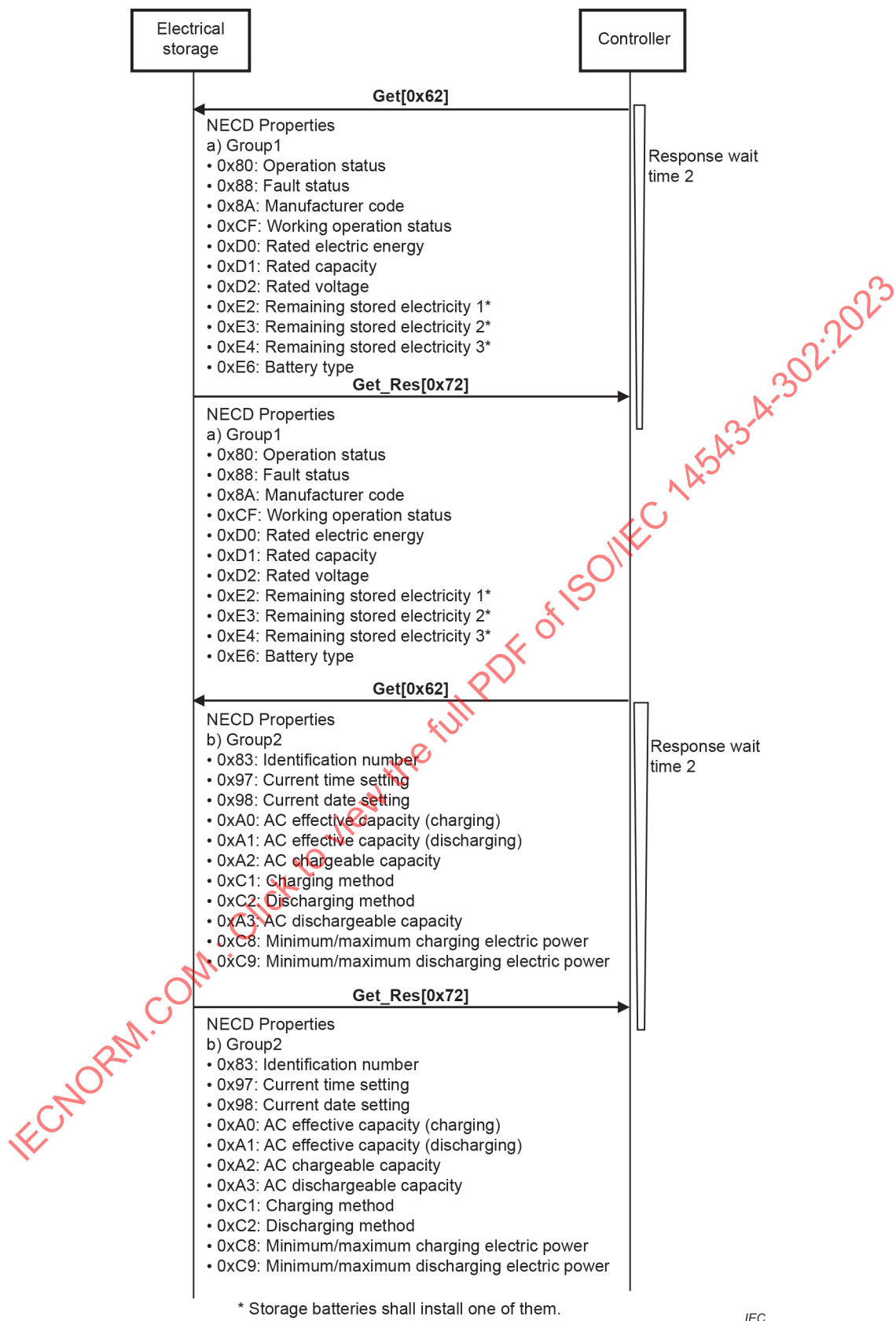


Figure 7 – Sequence of obtaining electrical storage system attribute information

7.3 Occasional operation

7.3.1 General

Subclauses 7.3.2 to 7.3.7 specify the operations on electrical storage systems and controllers when needed, called "occasional operation".

Sequences that are illustrated in 7.3 show the case that the electrical storage system implements all related properties. In case the electrical storage system does not implement one or some of the related properties, the electrical storage system shall respond SetC_SNA [0x51] and Get_SNA [0x52] instead of Set_Res [0x71] and Get_Res [0x72], respectively, in the sequences.

7.3.2 Obtaining electrical storage system status

Electrical storage systems status may be monitored by controllers as needed by obtaining the related properties.

1) Target properties of storage battery object

a) Group1

- 0x80: Operation status
- 0x88: Fault status
- 0xCF: Working operation status
- 0xDA: Operation mode setting
- 0xE2: Remaining stored electricity 1*
- 0xE3: Remaining stored electricity 2*
- 0xE4: Remaining stored electricity 3*

* Controllers shall obtain properties that are checked with the Get property map.

b) Group2

- 0x80: Operation status
- 0x88: Fault status
- 0xCF: Working operation status
- 0xDA: Operation mode setting
- 0xA4: AC chargeable electric energy
- 0xA5: AC dischargeable electric energy
- 0xA8: AC cumulative charging electric energy
- 0xA9: AC cumulative discharging electric energy
- 0xAA: AC charge amount target value
- 0xAB: AC discharge amount target value
- 0xDB: System-interconnected type

c) Group3

- 0x80: Operation status
- 0x88: Fault status
- 0xCF: Working operation status
- 0xC1: Charging method
- 0xC2: Discharging method
- 0xD3: Instantaneous charging and discharging electric power [optional]

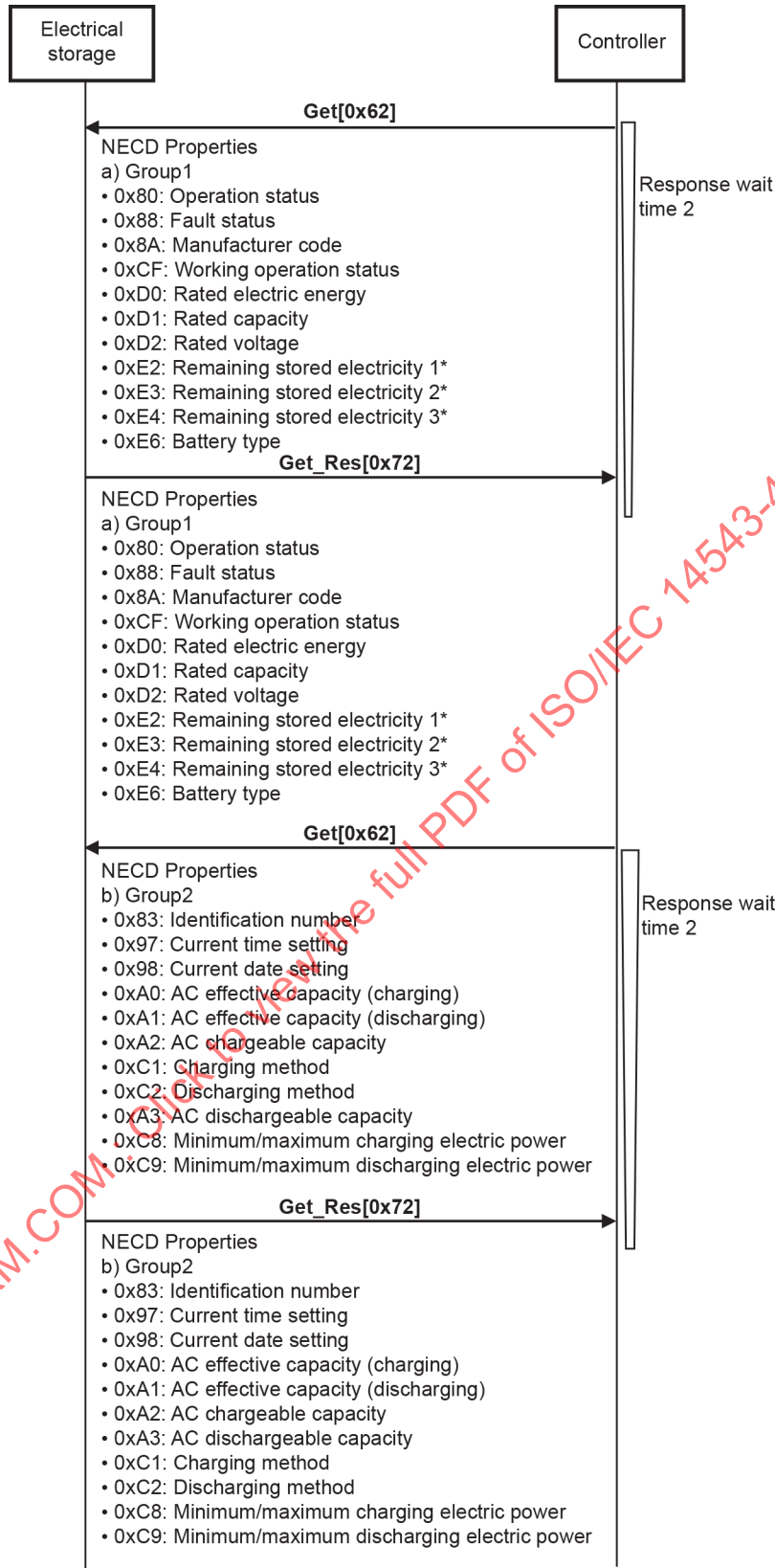
- 0xDA: Operation mode setting
- 0xEB: Charging electric power setting [optional]
- 0xEC: Discharging electric power setting [optional]

2) Sequence

Refer to Figure 8 for the operation sequence to obtain the status of electrical storage systems.

- a) A controller sends Get [0x62] via unicast to the target properties (in any combination or in any order) to obtain status of the electrical storage system.
- b) The electrical storage system returns Get_Res [0x72] to the controller.

IECNORM.COM : Click to view the full PDF of ISO/IEC 14543-4-302:2023



* Storage batteries shall install one of them.

IEC

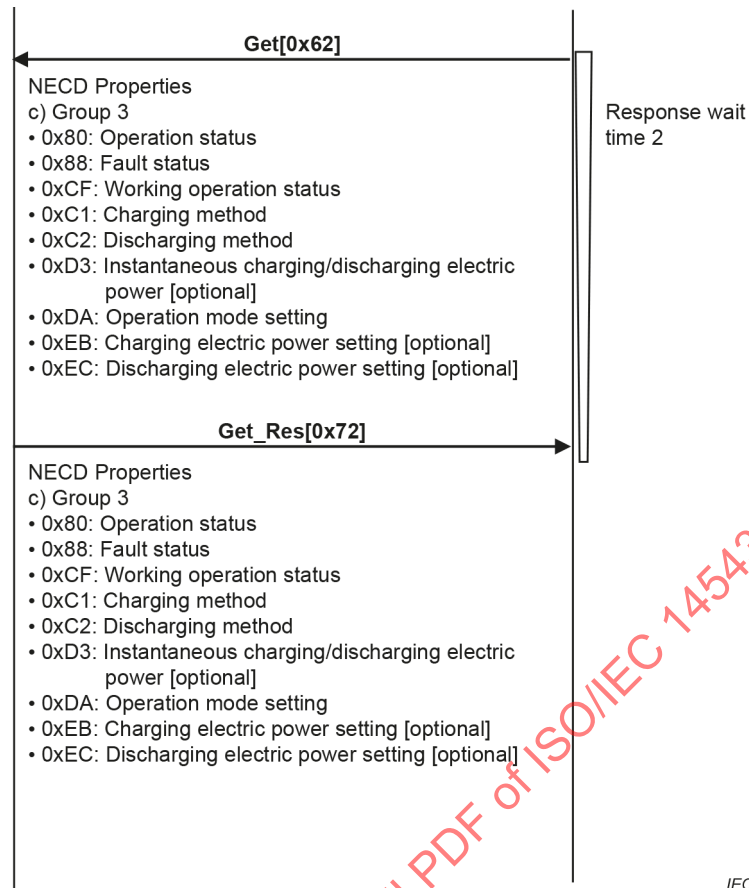


Figure 8 – Sequence to obtain status of electrical storage systems

7.3.3 Setting and updating "AC charge amount target value" property (or "AC discharge amount target value" property)

Controllers may order charging for a designated charging amount by setting "Operation mode setting" property [0xDA] to "Charging", after setting "AC charge amount target value" property [0xAA] to electrical storage systems. Controllers may also order discharging for a designated discharging amount by setting "Operation mode setting" property [0xDA] to "Discharging", after setting "AC discharge amount target value" property [0xAB] to electrical storage systems. The setting and updating "AC charge amount target value" property [0xAA] (or "AC discharge amount target value" property [0xAB]) are specified in this subclause 7.3.3, while 7.3.6 specifies operation mode settings and 7.3.7 specifies the termination of the charging (discharging) process based on "AC charge amount target value" property [0xAA] (or "AC discharge amount target value" property [0xAB]).

Controllers shall send SetC [0x61] for "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]). The following specifies setting the case of "AC charge amount target value" property [0xAA]: In the case of setting "AC discharge amount target value" property [0xAB], replace the description with the one placed within the brackets. Electrical storage systems shall accept and respond to these requests. Electrical storage systems shall send a status change notification (INF [0x73]) for "AC charge amount target value" property [0xAA] (or "AC discharge amount target value" property [0xAB]) at the earliest possible time within the wait time for re-setting the AC charge (or discharge) amount target value.

Controller should take the following action at the earliest possible time within the wait time for re-setting the AC charge (or discharge) amount target value specified in Table 6, when the time on response wait time 1 specified in Table 5 has elapsed without receiving Set_Res [0x71] or SetC_SNA [0x51], after sending SetC [0x61] for it.

- Controllers check the obtained value by sending Get [0x62] to "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]).

The status obtained by write Set_Res [0x71] or SetC_SNA [0x51], and the value obtained by Get [0x62] for "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) are expected to be provided to users or managers of the electrical storage systems as feedback. Electrical storage systems can require a certain amount of time (the "reflect" time) to update after receiving SetC [0x61] for "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) and cannot process continued write requests made within a short period. Therefore, controllers shall not send SetC [0x61] for "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) until either receiving the status change notification (INF [0x73]) for "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) or until the wait time for re-setting the AC charge (or discharge) amount target value has elapsed, after sending SetC [0x61] for it.

If "Operation mode setting" property [0xDA] is set to "Charging" ("Discharging"), electrical storage systems start charging (discharging) based on "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) and the cumulative value of energy from the moment of reflecting it. If "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) is set while "Operation mode setting" property [0xDA] is "Charging" ("Discharging"), the set value is reflected without re-setting "Operation mode setting" property [0xDA]. In this case, the electrical storage system starts charging (discharging) based on the cumulative value of energy from the moment it reflects the new value on "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]), regardless of the amount that was charged (discharged) before the reflection of it. Contrarily, if the property value of "Operation mode setting" property [0xDA] of the electrical storage system is something other than "Charging" ("Discharging"), the electrical storage system starts charging (discharging) after reflecting the new value on "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) and "Operation mode setting" property [0xDA] is set to "Charging" ("Discharging"). In this case, the electrical storage system starts charging (discharging) based on the cumulative value of energy from the moment "Operation mode setting" property [0xDA] is set to "Charging" ("Discharging"). The key points are as follows.

- a) While the electrical storage system's "Operation mode setting" property [0xDA] is "Charging" ("Discharging"), it shall not be switched to "Discharging" ("Charging"), even if controllers set "AC discharge amount target value" property [0xAA] ("AC charge amount target value" property [0xAB]). To switch the electrical storage system's "Operation mode setting" property [0xDA] to "Discharging" ("Charging"), controllers shall set "AC discharge amount target value" property [0xAA] ("AC charge amount target value" property [0xAB]), and then set "Operation mode setting" property [0xDA] to "Discharging" ("Charging"). After controllers perform a setting, the electrical storage system's "Operation mode setting" property [0xDA] or "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) can be changed by the operation of an individual remote controller or panels on the main body of the electrical storage system. Therefore, controllers should periodically monitor the status of the electrical storage system specified in 7.3.2.
- b) When controllers set an identical value with the current value set for electrical storage systems as "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]), a status change notification (INF [0x73]) of "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) may not be issued since the property value has not changed. Note that if "Operation mode setting" property [0xDA] is "Charging" ("Discharging") at the time, the timing to start tallying the electric energy amount will be updated. In those cases that controllers set an identical value with the current value as "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]), it is impossible to determine whether it is updated or not, even if controllers check the electrical storage system's "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]). Therefore, controllers should monitor "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) beforehand and should update it with a different value.

- c) If "0" is set as a property value when setting or updating "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]), then the electrical storage system shall determine the charging amount during charging (discharging amount during discharging) by itself.

Table 6 – Re-set wait time for the AC charge (or discharge) amount target value

Parameter name	Value
Re-set wait time for the AC charge (or discharge) amount target value.	At least 60 [s]

1) Target properties of storage battery object

Writing or reading "AC charge amount target value" property [0xAA]

- 0xAA: AC charge amount target value Set/Get

AC charge amount target value notification

- 0xAA: AC charge amount target value INF

Writing or reading "AC discharge amount target value" property [0xAB]

- 0xAB: AC discharge amount target value Set/Get

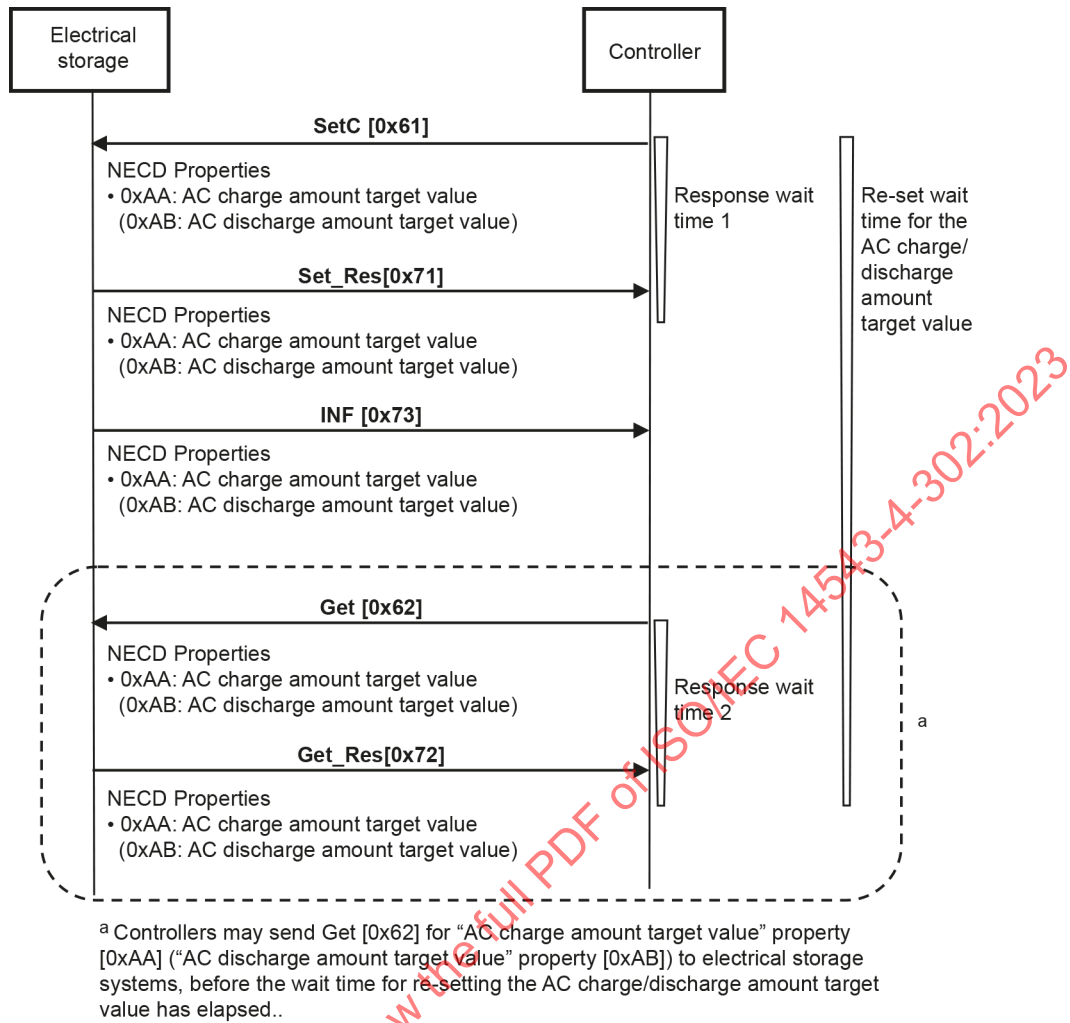
AC discharge amount target value notification

- 0xAB: AC discharge amount target value INF

2) Sequence

Figure 9 shows the sequence for setting "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]).

- Controllers send SetC [0x61] to "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) of electrical storage systems.
- When electrical storage systems receive SetC [0x61] from controllers, electrical storage systems return Set_Res [0x71] if the set value is within the value range installed on the actual electrical storage systems. If a set value is out of the value range installed on the actual electrical storage systems, electrical storage systems should send Set_Res [0x71] in which the set value is rounded to the highest or lowest value of the value range installed on them, or they may send SetC_SNA [0x51]. Note that electrical storage system's Set_Res [0x71] is an acceptance response instead of a processing response. In addition, electrical storage systems may send SetC_SNA [0x51] when the set value cannot be set during specific ongoing operations of electrical storage systems, such as autonomous operation or maintenance mode.
- Controllers shall not send the next SetC [0x61] either until a status change notification (INF [0x73]) from electrical storage systems of "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) is issued or until the wait time for re-setting the AC charge (or discharge) amount target value specified in Table 6 has elapsed. Controllers may send Get [0x62] for "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) to electrical storage systems, before the wait time for re-setting the AC charge (or discharge) amount target value specified in Table 6 has elapsed.
- If controllers send SetC [0x61] for "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) and the response wait time 1 specified in Table 5 has elapsed without receiving Set_Res [0x71] or SetC_SNA [0x51], controllers shall send Get [0x62] for "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) and check the obtained value.



IEC

Figure 9 – Sequence for setting "AC charge amount target value" property (or "AC discharge amount target value" property)

7.3.4 Setting and updating "Charging electric power setting" property (or "Discharging electric power setting" property) (optional)

Controllers may order charging at a designated charging power (or discharging at a designated discharging power) by setting "Charging" ("Discharging") to "Operation mode setting" property [0xDA], with setting "Designated electric power charging" to "Charging method" property [0xC1] ("Designated electric power discharging" to "Discharging method" property [0xC2]), after setting any electric power value to "Charging electric power setting" property [0xEB] ("Discharging electric power setting" property [0xEC]). The setting and updating "Charging electric power setting" property [0xEB] ("Discharging electric power setting" property [0xEC]) are specified in this subclause 7.3.4, while 7.3.6 specifies operation mode settings and 7.3.7 specifies the termination of the charging (discharging) process based on "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]).

Controllers shall send SetC [0x61] for "Charging electric power setting" property [0xEB] ("Discharging electric power setting" property [0xEC]). The following specifies charging electric power setting values. In the case of discharging electric power setting values, replace the description with the one placed within the bracket shown with it. When SetC [0x61] is received from controllers, electrical storage systems shall send Set_Res [0x71] if the set value is within the value range installed in the electrical storage system. Controllers shall take any of the following two actions at an earliest possible time within the wait time for re-setting the charging and discharging electric power setting specified in Table 7, when the time on response wait time 1 specified in Table 5 has elapsed without receiving Set_Res [0x71] or SetC_SNA [0x51], after sending any SetC [0x61] to "Charging electric power setting" property [0xEB] ("Discharging electric power setting" property [0xEC]).

- Controllers check the response by sending SetC [0x61] of the same as SetC [0x61] to "Charging electric power setting" property [0xEB] ("Discharging electric power setting" property [0xEC]) that is sent earlier.
- Controllers check the obtained value by sending Get [0x62] to "Charging electric power setting" property [0xEB] ("Discharging electric power setting" property [0xEC]).

The status obtained by Set_Res [0x71] or SetC_SNA [0x51], and the values obtained by Get [0x62] for "Charging electric power setting" property [0xEB] ("Discharging electric power setting" property [0xEC]) are expected to be provided to users or managers of the electrical storage systems as feedback.

Electrical storage systems require a certain amount of time to reflect the received set values after receiving SetC [0x61] for "Charging electric power setting" property [0xEB] ("Discharging electric power setting" property [0xEC]) and cannot process continued SetC [0x61] made within a short period. Therefore, controllers shall not send SetC [0x61] for "Charging electric power setting" property [0xEB] ("Discharging electric power setting" property [0xEC]) until the wait time for re-setting the charging and discharging electric power setting specified in Table 7 has elapsed, after sending SetC [0x61] for it.

If "Operation mode setting" property [0xDA] is set to "Charging" ("Discharging") when "Charging method" property [0xC1] ("Discharging method" property [0xC2]) is "Designated electric power charging" ("Designated electric power discharging"), electrical storage systems start charging (discharging) the electric power based on "Charging electric power setting" property [0xEB] ("Discharging electric power setting" property [0xEC]) from the moment of reflecting it. However, if "Charging electric power setting" property [0xEB] ("Discharging electric power setting" property [0xEC]) is set while "Charging method" property [0xC1] ("Discharging method" property [0xC2]) is "Designated electric power charging" ("Designated electric power discharging") and "Operation mode setting" property [0xDA] is set to "Charging" ("Discharging"), this set value is reflected without re-setting "Operation mode setting" property [0xDA] again. If "Operation mode setting" property [0xDA] is other than "Charging" ("Discharging"), this set value is reflected when "Operation mode setting" property [0xDA] is set to "Charging" ("Discharging").

Controllers should follow these points.

- While the electrical storage system's "Operation mode setting" property [0xDA] is "Charging" ("Discharging"), it is not switched to the opposite direction, "Discharging" ("Charging"), even if controllers set "Discharging electric power setting" property [0xEC] ("Charging electric power setting" property [0xEB]).
- In order to switch the charging and discharging direction, controllers shall set "Operation mode setting" property [0xDA] to "Discharging" ("Charging") after setting "Discharging method" property [0xC2] ("Charging method" property [0xC1]) to "Designated electric power discharging" ("Designated electric power charging"), and after setting the "Discharging electric power setting" property [0xEC] ("Charging electric power setting" property [0xEB]).
- Even after controllers perform a setting, electrical storage system's "Operation mode setting" property [0xDA] or "Charging electric power setting" property [0xEB] ("Discharging electric power setting" property [0xEC]) can be changed according to the operations on the individually-attached remote controllers or on the panels attached to the electrical storage systems.

- Therefore, controllers should periodically monitor the status of electrical storage systems as specified in 7.3.2.

Table 7 – Wait time for re-setting charging and discharging electric power setting

Parameter name	Value
Re-set wait time for the charging and discharging electric power setting	At least 60 [s]

1) Target properties of storage battery object

Writing or reading "Charging electric power setting" property [0xEB]

- 0xEB: Charging electric power setting (optional) Set/Get

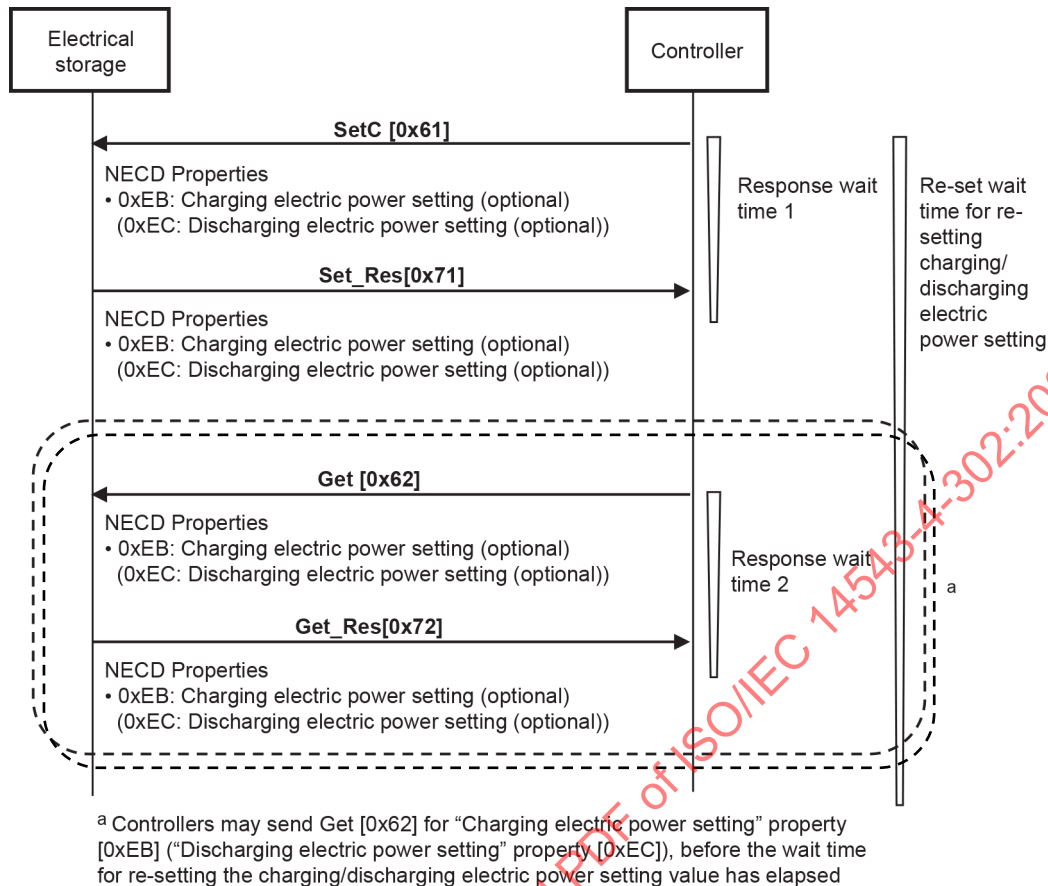
Writing or reading "Discharging electric power setting" property [0xEC]

- 0xEC: Discharging electric power setting (optional) Set/Get

2) Sequence

Figure 10 shows the sequence for setting "Charging electric power setting" property [0xEB] ("Discharging electric power setting" property [0xEC]).

- a) Controllers send SetC [0x61] for "Charging electric power setting" property [0xEB] (or "Discharging electric power setting" property [0xEC]) of electrical storage systems when setting.
- b) When electrical storage systems receive SetC [0x61] from controllers, each electrical storage system returns Set_Res [0x71] if the set value is within the value range installed on the actual electrical storage system. If the set value is out of the value range installed on the actual electrical storage system, controllers should take care that electrical storage systems may send Set_Res [0x71] after setting value rounded to the highest or lowest value of the value range installed on them as the property value (recommended), while there are some others that may send SetC_SNA [0x51]. In addition, electrical storage systems may send SetC_SNA [0x51] when they cannot set the set value during specific operations, such as autonomous operation or maintenance mode.
- c) If controllers send SetC [0x61] to "Charging electric power setting" property [0xEB] ("Discharging electric power setting" property [0xEC]) and the response wait time 1 specified in Table 5 has elapsed without receiving Set_Res [0x71] or SetC_SNA [0x51], controllers send Get [0x62] for "Charging electric power setting" property [0xEB] ("Discharging electric power setting" property [0xEC]) of the electrical storage system and check the obtained value.



IEC

Figure 10 – Sequence for setting "Charging electric power setting" property (or "Discharging electric power setting" property)

7.3.5 Setting "Charging method" property (or "Discharging method" property) (optional)

Controllers may send SetC [0x61] to "Charging method" property [0xC1] and "Discharging method" property [0xC2], as needed. The following specifies the case of charging. In the case of discharging, replace the description with the one contained in brackets. When SetC [0x61] is received from controllers, electrical storage systems shall send Set_Res [0x71] if the set value is within the value range installed in the electrical storage system. Electrical storage systems shall send a status change notification (INF [0x73]) for "Charging method" property [0xC1] ("Discharging method" property [0xC2]) at the earliest possible time within the wait time for re-setting charging and discharging method specified in Table 8. Also, controllers can verify the change of electrical storage system's "Charging method" property [0xC1] ("Discharging method" property [0xC2]) by receiving a status change notification (INF [0x73]) of "Charging method" property [0xC1] ("Discharging method" property [0xC2]) to be notified after sending SetC [0x61] for "Charging method" property [0xC1] ("Discharging method" property [0xC2]). After sending SetC [0x61] for "Charging method" property [0xC1] ("Discharging method" property [0xC2]), controllers shall take any of the following actions at least once at the earliest possible time, within the wait time for charging and discharging method for re-setting specified in Table 8, if the response wait time 1 specified in Table 5 has elapsed without receiving Set_Res [0x71] or SetC_SNA [0x51].

- Controllers check the response by sending SetC [0x61] for "Charging method" property [0xC1] ("Discharging method" property [0xC2]) that is the same as SetC [0x61] to "Charging method" property [0xC1] ("Discharging method" property [0xC2]) that is sent earlier.
- Controllers check the obtained value by sending Get [0x62] for "Charging method" property [0xC1] ("Discharging method" property [0xC2]).

The status obtained by Set_Res [0x71] or SetC_SNA [0x51], and values obtained by Get [0x62] for "Charging method" property [0xC1] ("Discharging method" property [0xC2]) are expected to be provided to users or managers of the electrical storage systems as feedback. Note that electrical storage systems need a certain amount of time to move into the charging or discharging operation after receiving SetC [0x61] for "Charging method" property [0xC1] ("Discharging method" property [0xC2]) from controllers. Therefore, after sending SetC [0x61] for "Charging method" property [0xC1] ("Discharging method" property [0xC2]), controllers shall not send another SetC [0x61] for "Charging method" property [0xC1] ("Discharging method" property [0xC2]) until either receiving a status change notification (INF [0x73]) of "Charging method" property [0xC1] ("Discharging method" property [0xC2]) or until the wait time for charging and discharging method for re-setting specified in Table 8 has elapsed. However, controllers may send another SetC [0x61] of the same value that is sent earlier for "Charging method" property [0xC1] ("Discharging method" property [0xC2]), if the response wait time 1 specified in Table 5 has elapsed without receiving Set_Res [0x71] or SetC_SNA [0x51], even before the wait time for re-setting charging and discharging method specified in Table 8 has elapsed.

Table 8 – Wait time for charging and discharging method for re-setting

Parameter name	Value
Wait time for re-setting charging and discharging method	At least 60 [s]

1) Target properties of storage battery object

Writing or reading "Charging method" property [0xC1] and "Discharging method" property [0xC2]

- 0xC1: Charging method Set (optional)/Get
- 0xC2: Discharging method Set (optional)/Get

Notifying status change of "Charging method" property [0xC1] and "Discharging method" property [0xC2]

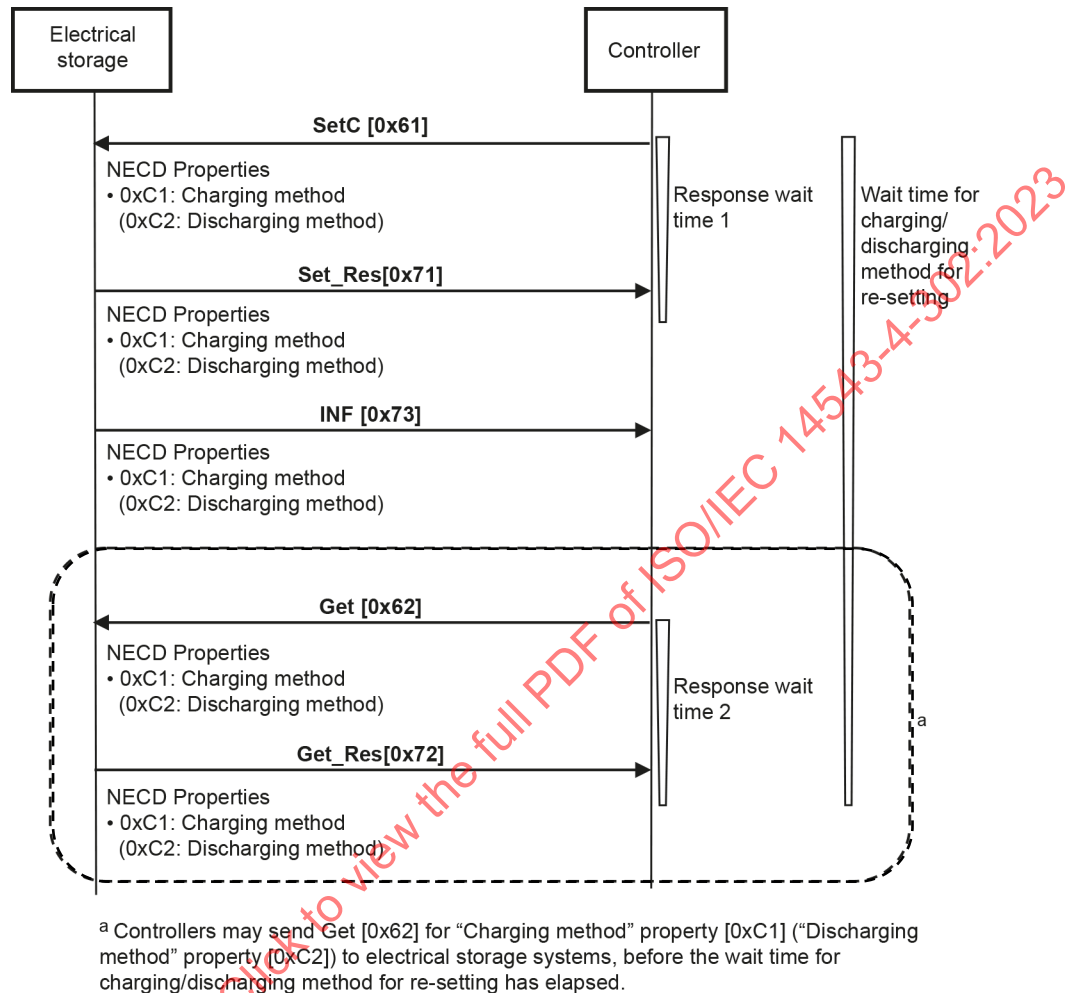
- 0xC1: Charging method INF
- 0xC2: Discharging method INF

2) Sequence

Figure 11 and Figure 12 show the sequences for setting "Charging method" property [0xC1] and "Discharging method" property [0xC2].

- Controllers send SetC [0x61] for "Charging method" property [0xC1] ("Discharging method" property [0xC2]) of the electrical storage system when writing "Charging method" property [0xC1] ("Discharging method" property [0xC2]) of electrical storage systems.
- When an electrical storage system receives SetC [0x61] from a controller, it returns Set_Res [0x71] if "Charging method" property [0xC1] ("Discharging method" property [0xC2]) is installed and the set value is within the value range installed on the actual electrical storage system. If "Charging method" property [0xC1] ("Discharging method" property [0xC2]) is not installed or the set value is out-of-range of the value installed on the actual electrical storage system, the electrical storage system sends SetC_SNA [0x51]. In addition, electrical storage systems may send SetC_SNA [0x51] to the controller if the electrical storage system cannot set the set value because of its autonomous operation or maintenance mode.
- Controllers shall not send the next SetC [0x61] either until a status change notification (INF [0x73]) of "Charging method" property [0xC1] ("Discharging method" property [0xC2]) is notified from the electrical storage system or until the wait time for charging and discharging method for re-setting specified in Table 8 has elapsed. Controllers may send Get [0x62] for "Charging method" property [0xC1] ("Discharging method" property [0xC2]) to electrical storage systems, before the wait time for charging and discharging method for re-setting specified in Table 8 has elapsed.

- d) If controllers send SetC [0x61] for "Charging method" property [0xC1] ("Discharging method" property [0xC2]) and the response wait time 1 specified in Table 5 has elapsed without receiving Set_Res [0x71] or SetC_SNA [0x51], controllers may send Get [0x62] for "Charging method" property [0xC1] ("Discharging method" property [0xC2]) to the storage battery.



IEC

Figure 11 – Sequence for setting "Charging method" property (or "Discharging method" property)

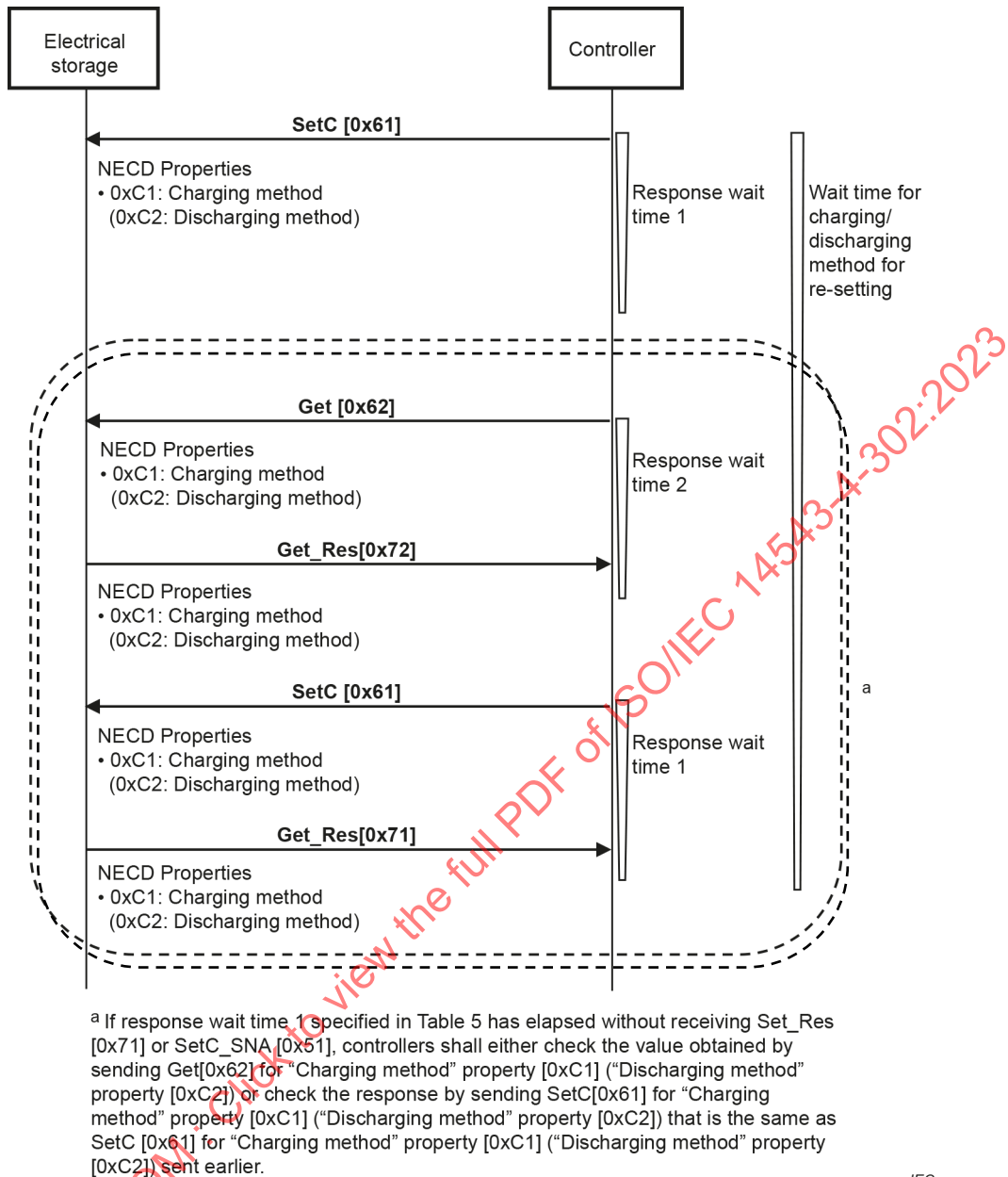


Figure 12 – Sequence for setting "Charging method" property (or "Discharging method" property) when no response is received from the storage battery

7.3.6 Setting "Operation mode setting" property

Controllers may send SetC [0x61] for "Operation mode setting" property [0xDA] for charging, discharging, etc, to electrical storage systems, as needed. When SetC [0x61] is received from controllers, electrical storage systems shall send Set_Res [0x71] if the set value is within the value range installed in the electrical storage system. Electrical storage systems shall send a status change notification (INF [0x73]) of "Operation mode setting" property [0xDA] at the earliest possible time within the wait time for re-setting operation modes specified in Table 9. Also, controllers may verify the change by receiving a status change notification (INF [0x73]) of "Working operation status" property [0xCF] to be issued after the status change notification (INF [0x73]) of "Operation mode setting" property [0xDA]. After sending SetC [0x61] for "Operation mode setting" property [0xDA], controllers shall take any of the following actions at least once at the earliest possible time, within the wait time for re-setting operation mode specified in Table 9, if the response wait time 1 specified in Table 5 has elapsed without receiving Set_Res [0x71] or SetC_SNA [0x51].

- Controllers shall check the response by sending SetC [0x61] for "Operation mode setting" property [0xDA] that is the same as SetC [0x61] to "Operation mode setting" property [0xDA] that is sent earlier.
- Controllers shall check the obtained value by sending Get [0x62] for "Operation mode setting" property [0xDA].

The status obtained by Set_Res [0x71] or SetC_SNA [0x51], and the value obtained by Get [0x62] for "Operation mode setting" property [0xDA] are expected to be provided to users or managers of the electrical storage systems as feedback. Note that electrical storage systems need a certain amount of time to move into charging or discharging operation after receiving SetC [0x61] for "Operation mode setting" property [0xDA] from controllers. Therefore, after sending SetC [0x61] for "Operation mode setting" property [0xDA], controllers shall not send another SetC [0x61] for "Operation mode setting" property [0xDA] until either receiving a status change notification (INF [0x73]) of "Working operation status" property [0xCF] or until the wait time for re-setting operation mode specified in Table 9 has elapsed. However, controllers may send another SetC [0x61] for "Operation mode setting" property [0xDA] with the same set value sent earlier, if response wait time 1 specified in Table 5 has elapsed after sending SetC [0x61] for "Operation mode setting" property [0xDA] without receiving Set_Res [0x71] or SetC_SNA [0x51], even before the wait time for re-setting operation mode specified in Table 9 has elapsed.

Table 9 – Wait time for re-setting operation mode

Parameter name	Value
Wait time for re-setting operation mode	At least 60 [s]

1) Target properties of storage battery object

Writing or reading "Operation mode setting" property [0xDA]

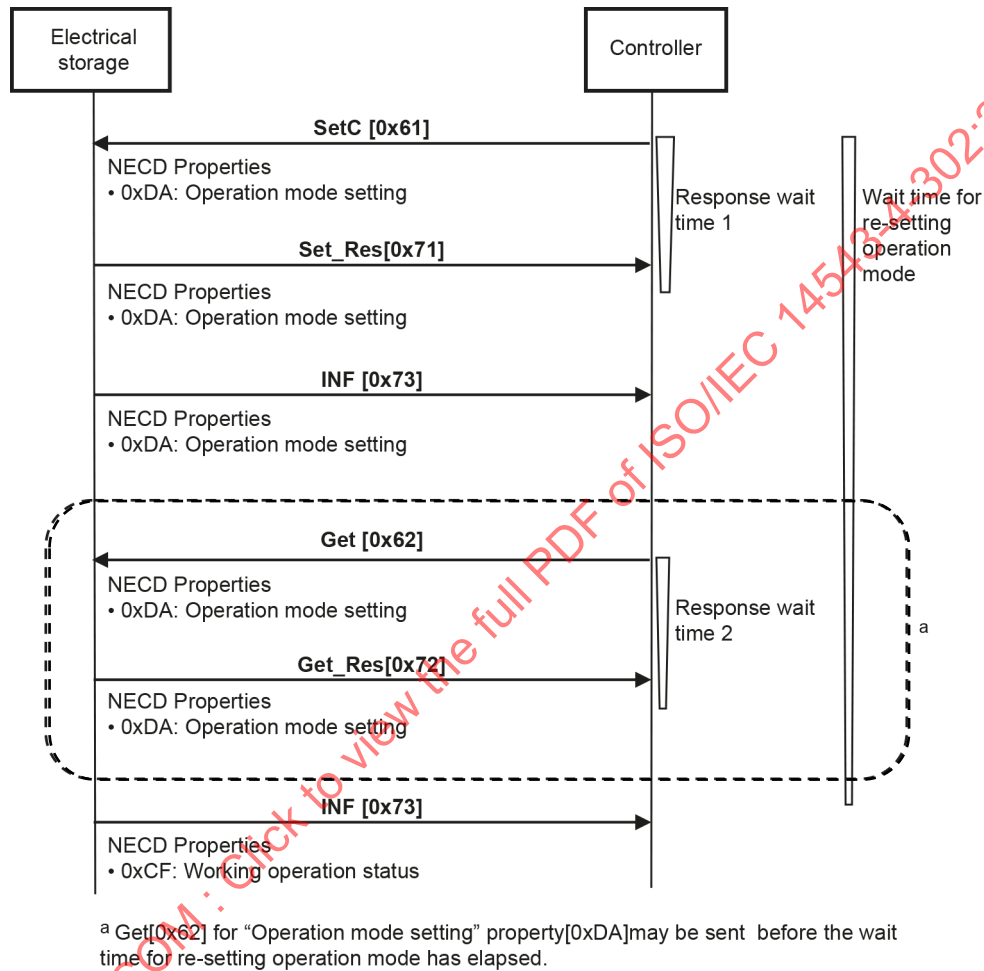
- 0xDA: Operation mode setting Set/Get
- "Working operation status" property [0xCF] notification
- 0x CF: Working operation status INF

2) Sequence

Figure 13 and Figure 14 show the sequence for setting "Operation mode setting" property [0xDA].

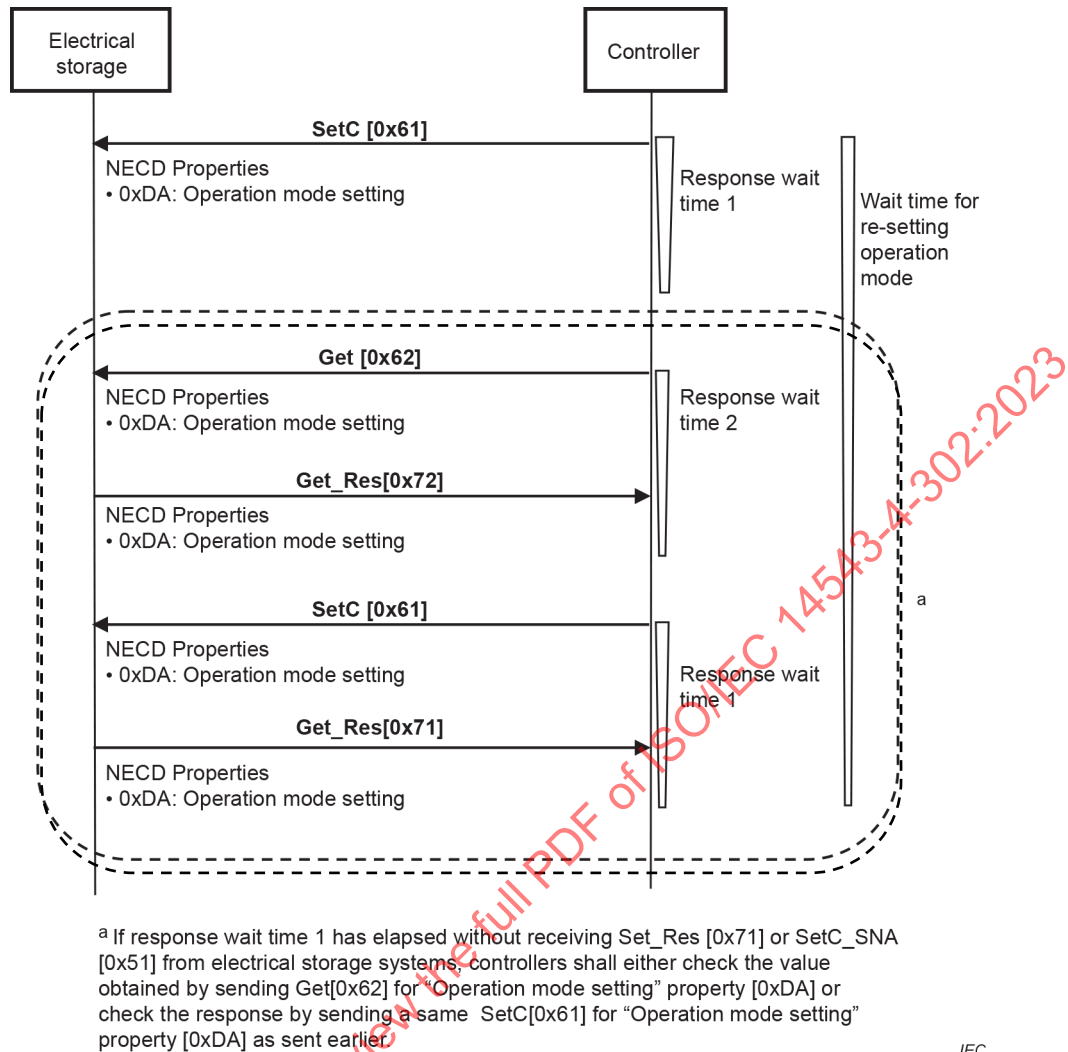
- a) Controllers send SetC [0x61] for "Operation mode setting" property [0xDA] to electrical storage systems.
- b) Electrical storage systems receive SetC [0x61] from controllers. If the set value is within the range installed on the electrical storage system, the electrical storage system shall send Set_Res [0x71], while sending SetC_SNA [0x51] if that is not installed. Note that electrical storage systems shall send Set_Res [0x71] as an acceptance response instead of the processing response. In addition, electrical storage systems may send SetC_SNA [0x51] to controllers if the electrical storage system cannot set the set value because of its autonomous operation or maintenance mode.
- c) Controllers shall not send SetC [0x61] for "Operation mode setting" property [0xDA] either until a status change notification (INF [0x73]) of "Working operation status" property [0xCF] is received from electrical storage systems or until the wait time for re-setting operation mode specified in Table 9 has elapsed. Controllers may send Get [0x62] for "Operation mode setting" property [0xDA] to the electrical storage system before the wait time for re-setting operation mode specified in Table 9 has elapsed.

- d) When the response wait time 1 specified in Table 5 has elapsed without receiving Set_Res [0x71] or SetC_SNA [0x51] after sending SetC [0x61] for "Operation mode setting" property [0xDA], controllers send SetC [0x61] for "Operation mode setting" property [0xDA] with the same value sent earlier again, and check the obtained value. Or, controllers send Get [0x62] for "Operation mode setting" property [0xDA] and check the obtained value from the electrical storage system. Note that the status obtained by Set_Res [0x71] or SetC_SNA [0x51], or the value obtained by Get [0x62] for "Operation mode setting" property [0xDA] may be provided to users or managers of the electrical storage systems as feedback.



IEC

Figure 13 – Sequence for setting "Operation mode setting" property



IEC

Figure 14 – Sequence for setting "Operation mode setting" property when no response is received from the storage battery

7.3.7 Terminating charging (or discharging) operation of the storage battery based on "AC charging amount target value" property (or "AC discharging amount target value" property)

If "AC charge amount target value" property [0xAA] (for the cases describing "AC discharge amount target value" property [0xAB], replace the description with the one placed in the brackets) has a value other than "0", and if "Operation mode setting" property [0xDA] is "Charging" ("Discharging"), when charging (discharging) operation based on "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) is completed (including the situations where chargeable capacity (dischargeable capacity) reaches "0"), electrical storage systems shall set "0" to "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) and set "Standby" to "Working operation status" property [0xCF]. However, the value of "Operation mode setting" property [0xDA] shall not be changed.

However, if electrical storage system's "Operation mode setting" property [0xDA] remains in "Charging" ("Discharging") and "Working operation status" property [0xCF] changes to "Standby" with sending a status change notification of it, and if the value of "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) remains other than "0", the situation shall be considered as temporarily wait due to the status of the electrical storage system. This means that the situation shall not be considered as termination of charging (discharging).

After "Working operation status" property [0xCF] changed to "Standby" as specified in above, status transition behaviour is different by products. Some electrical storage systems keep "Standby", while some others move to a previous state before controller's control. Therefore, in order to absorb the variation, controllers should send SetC [0x61] for "Operation mode setting" property [0xDA] after checking that "Working operation status" property [0xCF] is "Standby" and that "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) has value "0".

The following shows an example to set "Automatic" to "Operation mode setting" property [0xDA].

- If charging (or discharging) operation of the electrical storage system based on "AC charging amount target value" property [0xAA] (or "AC discharging amount target value" property [0xAB]) was terminated as specified above, controllers send SetC [0x61] to "Charging electric power setting" property [0xEB] ("Discharging electric power setting" property [0xEC]) with the value of "Maximum charging electric power" ("Maximum discharging electric power") of "Minimum/maximum charging electric power" property [0xC8] ("Minimum/maximum discharging electric power" property [0xC9]), and check receiving Set_Res [0x71]. Then, controllers send SetC [0x61] to "Charging method" property [0xC1] ("Discharging method" property [0xC2]) with "Maximum charge electric power charging" ("Maximum discharge electric power discharging"), and check receiving Set_Res [0x71] and the status change notification (INF [0x73]).
- Controllers send SetC [0x61] with "Automatic" to "Operation mode setting" property [0xDA], and check receiving SetC [0x71].

Note that charging (discharging) based on "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) is discontinued in the middle due to controllers by changing "Operation mode setting" property [0xDA] to "Discharging" ("Charging") or "Standby", electrical storage systems shall set "0" to "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]). In this case, note that "Operation mode setting" property [0xDA] and "Working operation status" property [0xCF] have changed to the newly set values. Therefore, controllers should check the termination status of electrical storage systems by using the status change notifications (INF [0x73]) of "Operation mode setting" property [0xDA], "Working operation status" property [0xCF], and "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]), and if necessary, by using information obtained by status monitoring (see 7.3.2 for details). In addition to this, controllers should send new SetC [0x61] to the electrical storage systems if necessary.

1) Target properties of storage battery object

Working operation status notification

- 0xCF: Working operation status INF

AC charge amount target value notification

- 0xAA: AC charge amount target value INF

AC discharge amount target value notification

- 0xAB: AC discharge amount target value INF

Changing charging electric power setting

- 0xEB: Charging electric power setting (optional) Set

Changing discharging electric power setting

- 0xEC: Discharging electric power setting (optional) Set

Changing charging method

- 0xC1: Charging method (optional) Set

Changing discharging method

- 0xC2: Discharging method (optional) Set

Charging method notification

- 0xC1: Charging method (optional) INF

Discharging method notification

- 0xC2: Discharging method (optional) INF

Changing operation mode

- 0xDA: Operation mode setting Set

Operation mode notification

- 0xDA: Operation mode setting INF

2) Sequence

Figure 15 and Figure 16 specify the termination sequences of charging (discharging) operation of electrical storage systems based on "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]).

- a) When charging (discharging) operation based on "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) is completed, the "Working operation status" property [0xCF] of the electrical storage system becomes "Standby", while "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]) becomes "0". For both properties, status change notifications (INF [0x73]) are sent. The order of the notifications depends on product implementation. Note that INF [0x73] may be sent with a multiple OPC instead of OPC = 1.

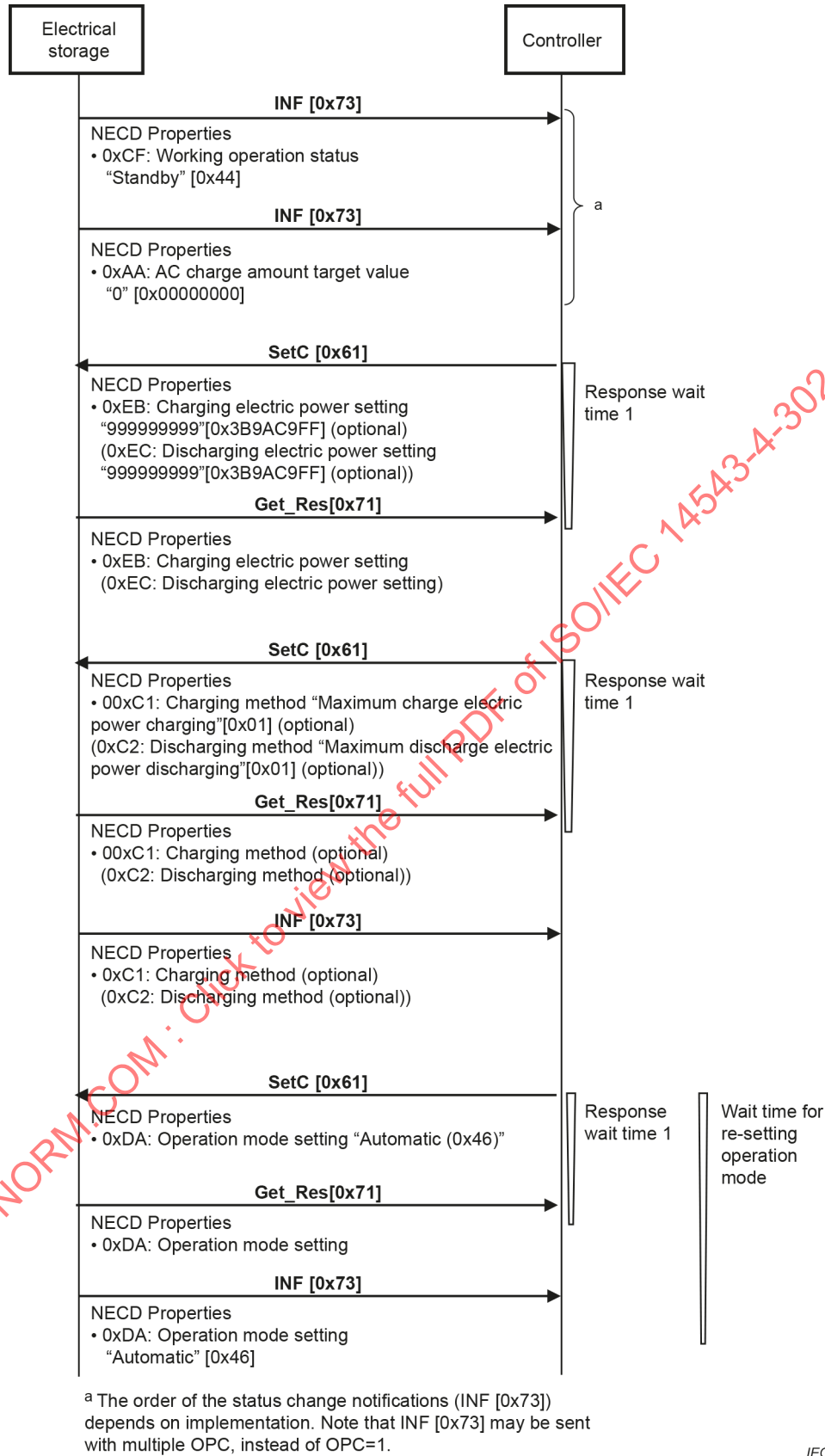
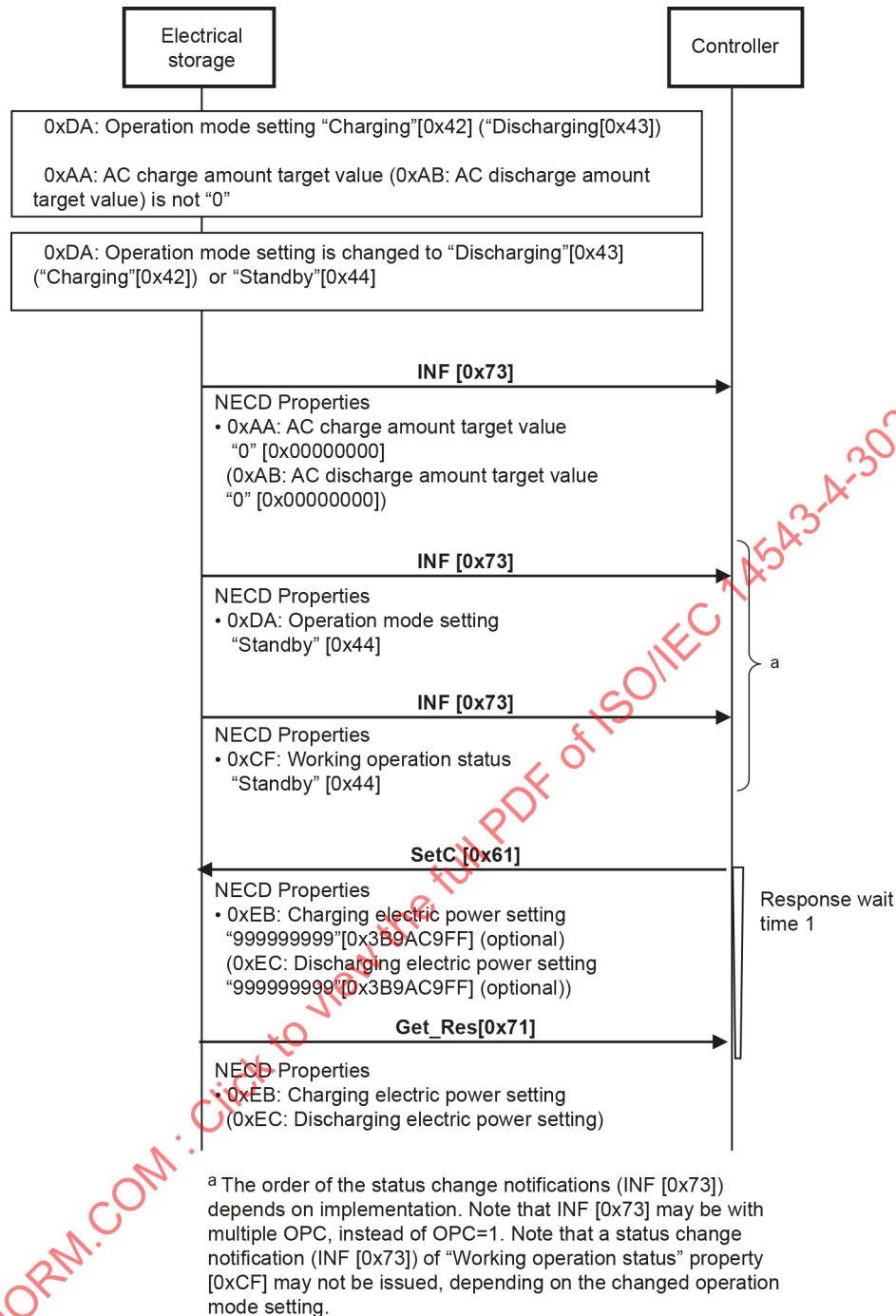


Figure 15 – Sequence of terminating charging (discharging) operation based on "AC charge amount target value" property ("AC discharge amount target value" property)



IEC

Figure 16 – Sequence of terminating charge (discharge) operation based on "AC charge amount target value" property ("AC discharge amount target value" property) when "Operation mode setting" property is changed

7.4 Fault status notification

If an electrical storage system encounters a fault for some cause, it shall change "Fault status" property [0x88] to "Fault occurred" sent to the controller. When the electrical storage system has recovered from the fault, it shall change "Fault status" property [0x88] to "No fault has occurred" sent to the controller.

The controller's behaviour when electrical storage systems are in fault status is not specified.

1) Target properties of storage battery object

- 0x88: Fault status

8 Remote control

8.1 General

When electrical storage systems are remotely controlled from outside the homes, controllers should take special care. Clause 8 specifies the special considerations with this "Remote control".

Figure 17 shows the concept of remote control.

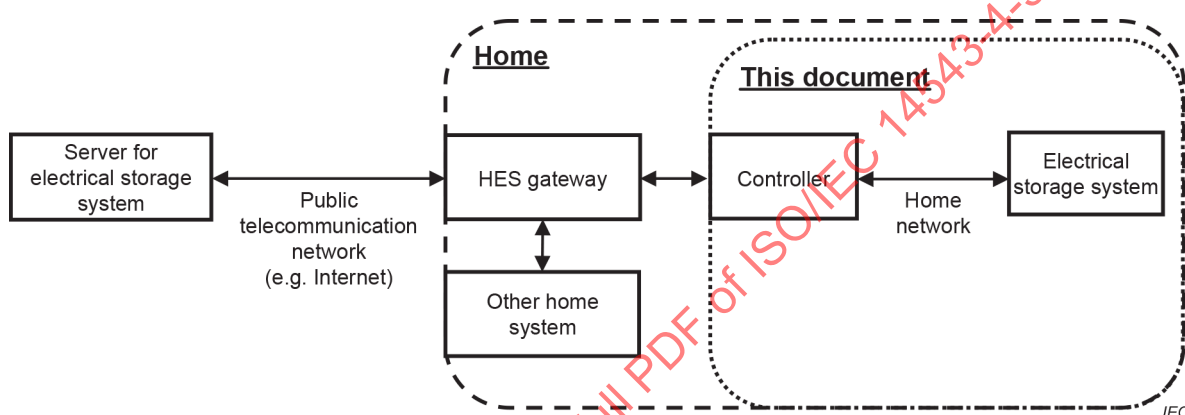


Figure 17 – Remote control

If remote commands are sent to the home via the public telecommunication network, an HES gateway function is required. Note that the communications on the public telecommunication network, the gateway function, communications between the gateway function and controller, and server for electrical storage system are out of scope and therefore implementation-dependent. The gateway function and controller may be implemented in one physical unit. In this case, communication between the gateway function and controller is internal. Annex B shows the relationship between ISO/IEC 14543-4 series and the HES gateway (ISO/IEC 15045 series and ISO/IEC 18012 series).

When controllers remotely control devices, the controllers shall send SetC [0x93] to electrical storage systems with multiple properties (i.e. OPC is more than 1) and shall put "Remote control setting" property [0x93] at the first position of the write properties. In advance of SetC, controllers should uniquely identify electrical storage systems by reading "Identification number" property [0x83] of the node profile object or the storage battery object.

8.2 Setting and updating "AC charge amount target value" property (or "AC discharge amount target value" property) on remote control

Controllers shall send SetC [0x61] for "AC charge amount target value" property [0xAA] ("AC discharge amount target value" property [0xAB]), adding "Remote control setting" property [0x93] at the first position of SetC [0x61]. Subclause 8.2 specifies writing "AC charge amount target values" property [0xAA]: In the case of "AC discharge amount target values" property [0xAB], replace the description with the one placed within the bracket shown with it. For description other than "Remote control setting" property [0x93], see 7.3.3.