

Minutes of IEEE SCC21 P1547.4 Draft Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power Systems Work Group (WG) Meeting of August 5 - 6, 2004 Las Vegas NV

1.0 Executive Summary

This was the inaugural meeting of the work group with the meeting focus to establish initial topics and issues for P1547.4 consideration. Participants (**Annex A**) established an initial draft outline/table of contents (**Annex D**) and drafted a number of configurations of DR island system types for consideration (**Annex E**). The **Annexes D and E** provide discussion points laying the roadwork to ongoing efforts in developing P1547.4.

The next P1547.x series of meetings is tentatively scheduled for February – March 2005.

Note: these minutes will be posted on the IEEE SCC21.4 P1547.4 web site http://grouper.ieee.org/groups/scc21/1547.4/1547.4_index.html on the P1547.4 Archives page (under development), and, the initial outline will be posted at the P1547.4 Work Group Area (password protected; under development).

2.0 Meeting Notes

The meeting agenda and information materials were handed out. We reviewed the draft agenda, introduced ourselves, and, reviewed the IEEE P1547.4 scope and purpose, IEEE standards development practices, P1547.4 web site and list server, and the scope and purposes of the other 1547 series of standards documents (**Annex B**). Chairman Ben Kroposki presented general background on distribution system operation concepts, 1547 definitions, potential DR island configurations/applications, and an initial topical outline to kick off general discussion of topics for P1547.4 discussion (**Annex C**). General discussion resulted in a draft outline/table of contents (**Annex D**), and a number of configurations of DR island system types (**Annex E**) for future consideration.

Further details of the meeting are stated under the following Annexes.

ANNEX A: Attendees (1 page)

ANNEX B: P1547.4 WG Meeting Agenda/Opening Presentation (9 pages)

ANNEX C: P1547.4 Background for General Discussion (5 pages)

ANNEX D: P1547.4 Meeting Notes On Open Discussion of Document (7 pages)

ANNEX E: P1547.4 Types of DR Island Systems (4 pages)

3.0 Adjournment

Chairman Ben Kroposki thanked everyone for their participation and adjourned the P1547.4 work group meeting. We proceeded to the P1547.2 meeting next door and presented highlights of our meeting to that group. The next P1547.x series of meetings is tentatively scheduled for February – March 2005.

Respectfully Submitted, B. Kroposki, Chair P1547.4 and, T. Basso, Secretary P1547.4.

(ANNEXES to minutes follow)

Annex A P1547.4 Meeting August 5 - 6, 2004 Las Vegas NV
Meeting Attendees

Ben Kroposki, Chair
Benjamin_Kroposki@nrel.gov
303 275-2979
Tom Basso, Secretary
thomas_basso@nrel.gov
303 275-3835
Mark Antkowiak
Bill Ash
Doug Birlingmair
David Costyk
James Daley
Murray Davis
Richard DeBlasio
Paul Dolloff

Joseph Koepfinger
Ljubomir Kojovic
Frank Lambert
Richard Langley
Kevin Loving
Sylvain Martel
Anthony Mazy
Gary Olson
Michael Ryan
John Stevens
Charles Watson
Robert Wills
Sam Ye
Rui Zhou

IEEE SCC21 1547™ Series Standards Development
Working Group Meetings Las Vegas NV August 3 - 6, 2004

Minutes Annex B: Agenda and Opening Presentation

P1547.4 Draft Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power Systems

Chairperson: Ben Kroposki

Secretary: Tom Basso



P1547.4 Project Description

Title. P1547.4 Draft Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power Systems

Scope. This document provides alternative approaches and good practices for the design, operation, and integration of distributed resource (DR) island systems with electric power systems (EPS). This includes the ability to separate from and reconnect to part of the area EPS while providing power to the islanded local EPSs. This guide includes the distributed resources, interconnection systems, and participating electric power systems.

Purpose. This guide is intended to be used by EPS designers, operators, system integrators, and equipment manufacturers. The document is intended to provide an introduction, overview and address engineering concerns of DR island systems. It is relevant to the design, operation, and integration of DR island systems. Implementation of this guide will expand the benefits of using DR by targeting improved electric power system reliability and build upon the interconnection requirements of IEEE 1547.

Chairperson: Ben Kroposki

Secretary: Tom Basso

PAR approved by IEEE March 2004 (project authorization request); ballot to be completed by December 2007



Agenda P1547.4 Aug 5 – 6, 2004

- Welcome and Introductions
- IEEE Standards Development
- 1547 Series of Standards
- P1547.4 Draft Content Discussion
- Timeline and Next Actions
- Adjourn



Welcome and Introductions

Please sign in on the attendee list

correct and/or add your contact
information



IEEE Standards Development

IEEE Instructions - the WG membership shall be advised that:

- IEEE's Patent Policy is consistent with the ANSI patent policy and is described in Clause 6 of the IEEE SA Standards Board Bylaws;
- Early disclosure of patents which may be essential for the use of standards under development is encouraged -- WG members should identify or disclose patents that you believe may be essential for the use of this standard; responses (specifically the patents and patent applications identified, if any, and by whom) will be recorded in this meeting's minutes.
- Disclosures made of such patents may not be exhaustive of all patents that may be essential for the use of standards under development, and neither the IEEE, the WG nor the WG Chairman ensure the accuracy or completeness of any disclosure or whether any disclosure is of a patent that in fact may be essential for the use of standards under development.



IEEE-SA Standards Board Bylaws on Patents in Standards

6. Patents. IEEE standards may include the known use of essential patents and patent applications provided the IEEE receives assurance from the patent holder or applicant with respect to patents whose infringement is, or in the case of patent applications, potential future infringement the applicant asserts will be, unavoidable in a compliant implementation of either mandatory or optional portions of the standard [essential patents]. This assurance shall be provided without coercion and prior to approval of the standard (or reaffirmation when a patent or patent application becomes known after initial approval of the standard). This assurance shall be a letter that is in the form of either:

- a) A general disclaimer to the effect that the patentee will not enforce any of its present or future patent(s) whose use would be required to implement either mandatory or optional portions of the proposed IEEE standard against any person or entity complying with the standard; or
- b) A statement that a license for such implementation will be made available without compensation or under reasonable rates, with reasonable terms and conditions that are demonstrably free of any unfair discrimination.

This assurance shall apply, at a minimum, from the date of the standard's approval to the date of the standard's withdrawal and is irrevocable during that period.



Approved by IEEE-SA Standards Board – March 2003 (Revised February 2004)

Inappropriate Topics for IEEE WG Meetings

- Don't discuss licensing terms or conditions
- Don't discuss product pricing, territorial restrictions or market share
- Don't discuss ongoing litigation or threatened litigation
- Don't be silent if inappropriate topics are discussed... do formally object.

If you have questions, contact the IEEE-SA Standards Board Patent Committee Administrator at patcom@ieee.org or visit <http://standards.ieee.org/board/pat/index.html>

Approved by IEEE-SA Standards Board – March 2003 (Revised February 2004)



P1547.4 IEEE Web Site

P1547.4 public web site (more to add)

http://grouper.ieee.org/groups/scc21/1547.4/1547.4_index.html

- **P1547.4 Archives**
Will include:
 - **Meeting information**
 - **Registration Information – First time attendees, please return a completed registration form (Excel 24 KB) to Sara Huntley and Tom Basso, the SCC21 secretary, at least two weeks before the meeting. Ongoing attendees, please RSVP and provide any changes to your contact information.**
 - **Agenda – for most recent meeting**
 - **Minutes**



P1547.4 Web Site – Work Group Area

- P1547.4 Work Group Area (password protected)
(To Be Determined - TBD)
<http://grouper.ieee.org/groups/scc21/1547.4/private/>
username TBD password TBD

Will include:

- Contacts – WG member information (standards development use only).
- Special Topics - background information for the Work Group.
- StdDrafts – Drafts under development
- Listserv – listserv archived emails



P1547.4 IEEE ListServ

ListServ is for IEEE standards development use only.
IEEE code of ethics identified in Information file sent to each subscriber.

To: stds-p1547-4@ieee.listserv.org

From: you@yourISP.com

Only subscribers can send to the list. Exchanges between individuals and among your self-established small groups are encouraged.

ListServ emails are immediately sent to all subscribers;

Reply to all – sent to all;

Reply to sender – only sent to sender.

Email to listserv is auto-archived at

P1547.4 Work Group Area (password protected)
at ListServ (To Be Determined - TBD)

Archived emails can be viewed either under
Subject Thread or Date Thread.



IEEE Standards Classification

Standard: documents with mandatory requirements
(shall)

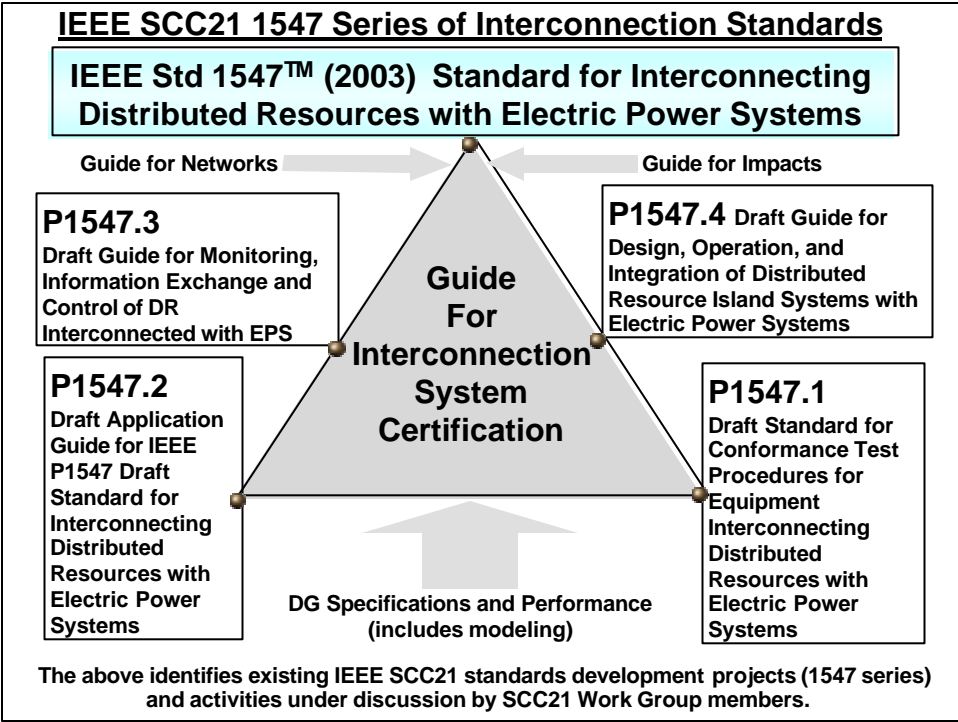
Recommended Practice: documents in which
procedures and positions preferred
by the IEEE are presented (**should**)

Guide: documents in which alternative approaches
to good practice are suggested but
no clear-cut recommendations are made (**may**)



IEEE Standards Board Standards Coordinating Committee 21 (SCC21): IEEE Std 1547 Published July 2003





Current SCC21 Interconnection Projects

Title	Scope & Purpose
IEEE Std 1547™ (2003) Standard for Interconnecting Distributed Resources with Electric Power Systems (approved June 2003)	<ul style="list-style-type: none"> This Standard establishes criteria and requirements for interconnection of distributed resources (DR) with electric power systems (EPS). This document provides a uniform standard for interconnection of distributed resources with electric power systems. It provides requirements relevant to the performance, operation, testing, safety considerations, and maintenance of the interconnection.
P1547.1 Draft Standard for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems	<ul style="list-style-type: none"> This Standard specifies the type, production, and commissioning tests that shall be performed to demonstrate that interconnection functions and equipment of a distributed resource (DR) conform to IEEE Std 1547. Interconnection equipment that connects distributed resources (DR) to an electric power system (EPS) must meet the requirements specified in IEEE Standard P1547. Standardized test procedures are necessary to establish and verify compliance with those requirements. These test procedures must provide both repeatable results, independent of test location, and flexibility to accommodate a variety of DR technologies.

Current SCC21 Interconnection Projects

Title	Scope and Purpose
P1547.2™ Draft Application Guide for IEEE Standard 1547 for Interconnecting Distributed Resources with Electric Power Systems	<ul style="list-style-type: none"> • This Guide provides technical background and application details to support the understanding of IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems. • This document facilitates the use of IEEE 1547 by characterizing the various forms of distributed resource technologies and the associated interconnection issues. Additionally, the background and rationale of the technical requirements are discussed in terms of the operation of the distributed resource interconnection with the electric power system. Presented in the document are technical descriptions and schematics, applications guidance and interconnection examples to enhance the use of IEEE 1547.
P1547.3™ Draft Guide for Monitoring, Information Exchange and Control of Distributed Resources Interconnected with Electric Power Systems	<ul style="list-style-type: none"> • This document provides guidelines for monitoring, information exchange, and control for distributed resources (DR) interconnected with electric power systems (EPS). • This document facilitates the interoperability of one or more distributed resources interconnected with electric power systems. It describes functionality, parameters and methodologies for monitoring, information exchange and control for the interconnected distributed resources with, or associated with, electric power systems. Distributed resources include systems in the areas of fuel cells, photovoltaics, wind turbines, microturbines, other distributed generators, and, distributed energy storage systems.

Current SCC21 Interconnection Projects

Title	Scope and Purpose
P1547.4™ Draft Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power Systems	<ul style="list-style-type: none"> • This document provides alternative approaches and good practices for the design, operation, and integration of distributed resource (DR) island systems with electric power systems (EPS). This includes the ability to separate from and reconnect to part of the area EPS while providing power to the islanded local EPSs. This guide includes the distributed resources, interconnection systems, and participating electric power systems. • This guide is intended to be used by EPS designers, operators, system integrators, and equipment manufacturers. The document is intended to provide an introduction, overview and address engineering concerns of DR island systems. It is relevant to the design, operation, and integration of DR island systems. Implementation of this guide will expand the benefits of using DR by targeting improved electric power system reliability and build upon the interconnection requirements of IEEE 1547.

P1547.4 Draft Content Discussion

IEEE Standards Style Manual to be used – IEEE refers to Chapters or sections as “Clauses”

<http://standards.ieee.org/resources/index.html#guides>

Introduction (... history of the standard, a description of its purpose,... 1547 series).

- 1. Overview (scope, purpose, use)**
- 2. References**
- 3. Definitions and Acronymns**
- 4 ... and more clauses added as needed, e.g., to be determined from today’s Engineering Concerns Discussion, etc.**

...

Annex A – Bibliography

Annex B? – Example DR Island Applications?

Annex etc. as needed



Timeline and Next Actions

- P1547.4 WG participants provide their contact information to P1547.4 officers.**
- Participants provide outline topics for consideration (with one line description or rationale) to P1547.4 officers.**
- P1547.4 officers establish strawman outline for discussion based on inputs.**

- Next Meeting – TBD (Jan - Mar 2005)**

- Adjourn: noon Aug. 6, 2004**



Minutes Annex C: Background for General Discussion

P1547.4 Draft Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power Systems

General Discussion

Chairperson: Ben Kroposki

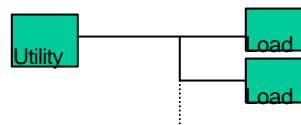
Secretary: Tom Basso

1

Distribution System Operational Concepts

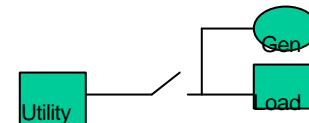
• **Radial Distribution System –**

The most common type of connection between utility and load.
Power only flows from utility to load.



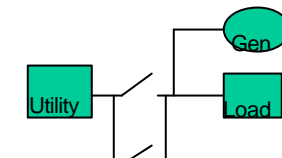
• **Intentional Island (also known as DR island system, minigrid, or microgrid)-**

Aggregation of loads and sources capable of operating either in parallel with or independent from a larger electric grid, while providing continuous power to end users. Depending on configuration, power flows only within microgrid or can export power to utility.



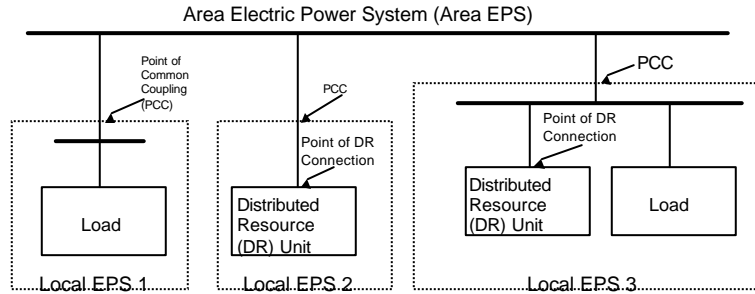
• **Networked Distribution System w/ 2-way power flow -**

Distribution in which the secondaries of the distribution transformers are connected in a grid, typically energized at the customers' utilization voltage, to serve multiple loads.



2

IEEE 1547 Diagram and Definitions



Note: Dashed lines are EPS boundaries. There can be any number of Local EPSs

IEEE 1547 Definitions

distributed resource: sources of electric power that are not directly connected to a bulk power transmission system. DR includes both generators and energy storage technologies.

electric power system (EPS): facilities that deliver electric power to a load. Note: This may include generation units.

Area electric power system (Area EPS): an electric power system (EPS) that serves Local EPSs. Note: Typically, an Area EPS has primary access to public rights-of-way, priority crossing of property boundaries, etc., and is subject to regulatory oversight.

Local electric power system (Local EPS): an EPS contained entirely within a single premises or group of premises.

island: a condition in which a portion of an Area EPS is energized solely by one or more Local EPSs through the associated PCCs while that portion of the Area EPS is electrically separated from the rest of the Area EPS.

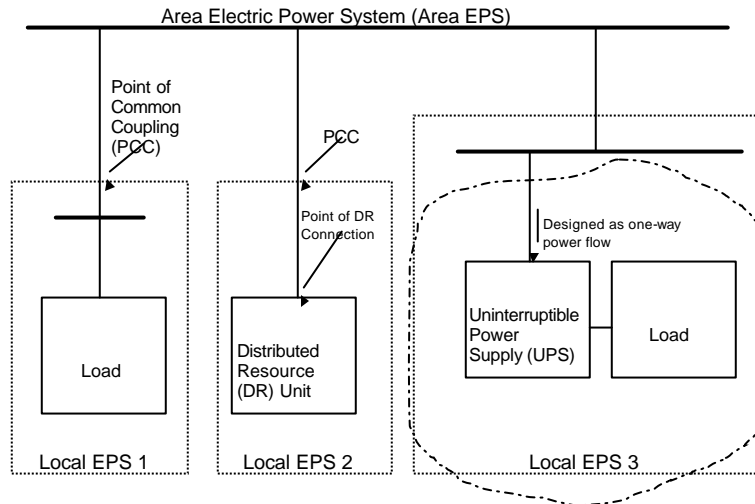
intentional island: a planned island.

point of common coupling (PCC): the point where a Local EPS is connected to an Area EPS.

point of DR connection: the point where a DR unit is electrically connected in an EPS.

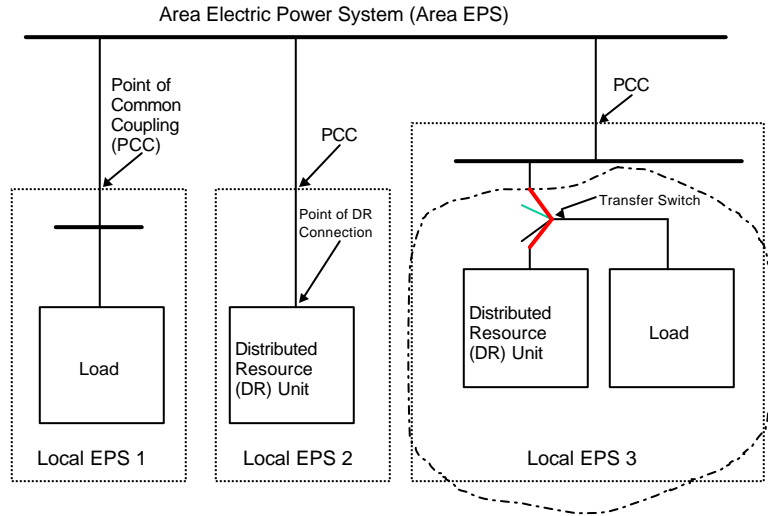
3

UPS Application



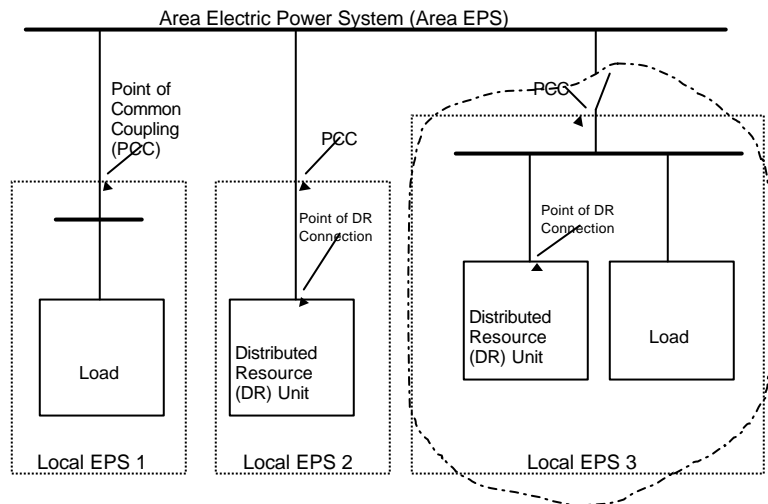
4

Transfer/ Parallel Switch Application

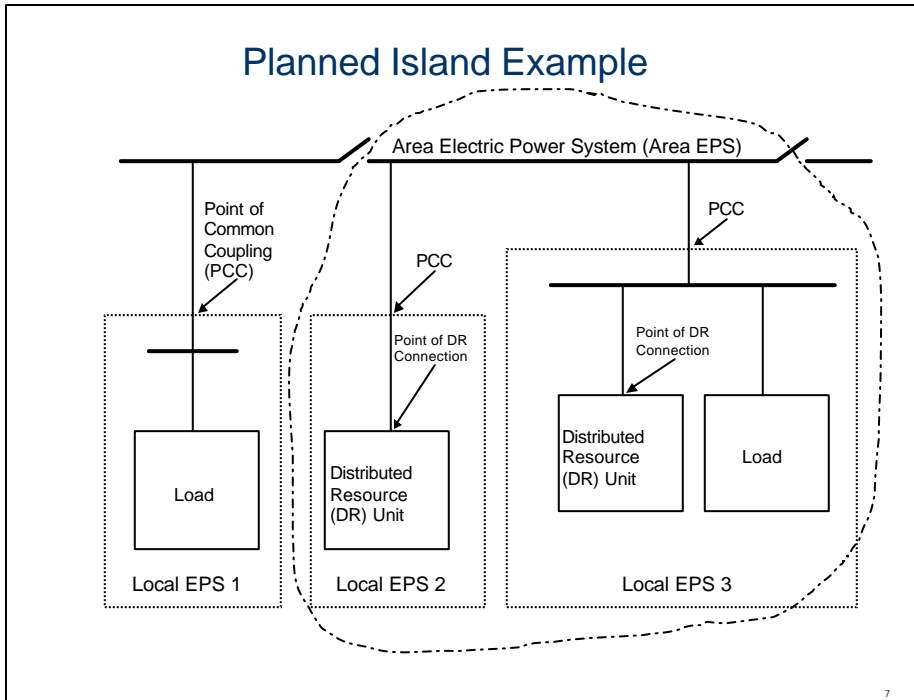


5

“Facility Microgrid” Example



6



P1547.4 Draft Content Discussion

Introduction (... history of the standard, a description of its purpose,... 1547 series).

1. Overview (scope, purpose, use)

2. References

3. Definitions and Acronyms

4. Clauses...

- **Types of Islands**
- **Engineering Concerns**
- **Engineering Solutions**
- **Design of Islands**
- **Operations of Islands**
- **Etc.**

Annex A – Bibliography

Annex B? – Example DR Island Applications?

Annex etc. as needed

P1547.4 Draft Content Discussion

Reference Documents – Send to Ben or Tom

Let's discuss topics for consideration within the document

Annex D P1547.4 Meeting August 5 - 6, 2004 Las Vegas NV **Meeting Notes on Open Discussion of Document**

Notes of AUGUST 5, 2004

1. Presentation of PAR P1547.4 Information

Title. P1547.4 Draft Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power Systems

Scope. This document provides alternative approaches and good practices for the design, operation, and integration of distributed resource (DR) island systems with electric power systems (EPS). This includes the ability to separate from and reconnect to part of the area EPS while providing power to the islanded local EPSs. This guide includes the distributed resources, interconnection systems, and participating electric power systems.

Purpose. This guide is intended to be used by EPS designers, operators, system integrators, and equipment manufacturers. The document is intended to provide an introduction, overview and address engineering concerns of DR island systems. It is relevant to the design, operation, and integration of DR island systems. Implementation of this guide will expand the benefits of using DR by targeting improved electric power system reliability and build upon the interconnection requirements of IEEE 1547.

2. Background Information for Discussion Consideration

IEEE 1547 Definitions

- **distributed resource:** sources of electric power that are not directly connected to a bulk power transmission system. DR includes both generators and energy storage technologies.
- **electric power system (EPS):** facilities that deliver electric power to a load. Note: This may include generation units.
- **Area electric power system (Area EPS):** an electric power system (EPS) that serves Local EPSs. Note: Typically, an Area EPS has primary access to public rights-of-way, priority crossing of property boundaries, etc., and is subject to regulatory oversight.
- **Local electric power system (Local EPS):** an EPS contained entirely within a single premises or group of premises.
- **island:** a condition in which a portion of an Area EPS is energized solely by one or more Local EPSs through the associated PCCs while that portion of the Area EPS is electrically separated from the rest of the Area EPS.

- **intentional island:** a planned island.
- **DR Island Systems:** ... are composed of at least one local EPS having DR ...? system ...
- **point of common coupling (PCC):** the point where a Local EPS is connected to an Area EPS.
- **point of DR connection:** the point where a DR unit is electrically connected in an EPS.

3. Brainstorming Topics for P1547.4 Outline Consideration

Introduction (... history of the standard, a description of its purpose,... 1547 series).

1. Overview (scope, purpose, use)

Scope and purpose clarification: distribution systems only?

Subtransmission? Voltage level(s)?; Max V = 10MVA?

2. References (IAS draft Std island protection)

1547

3. Definitions and Acronyms

4. Clauses...

Types of DR Island Systems

- facility microgrid (does not include any part of Area EPS)
- planned island with part of Area EPS
- “larger” island systems (a municipality with a portion of another Area EPS)

Engineering Concerns

Integration issues, e.g., volt regulation – within island as well as across “EPS”; communications (MIC); load sharing; dispatch within the island; generation shedding; energy storage; seamless transfer vs shutdown and resync; stability (single and multigens); synchronous, inverter, induction based machines; grounding and neutrals; power quality (transitions, ...); system protection (including surge protection); response to abnormal conditions; safety of units and ... (DR, power lines that would otherwise be expected to be safe, etc.); unintentional islanding (protection); load profile; load management; load shedding; power transient; mechanical issues (noise, emissions, fuels; out of scope?); frequency and voltage control; concerns; metering?; consider each subclause of 1547 wrt this activity; economic dispatch, e.g., pricing structure, etc.?; generation and system reliability (IEEE gold book); dynamics and (re)-configurability of Area EPS; interoperability of DR; blackstart; transformers (and other equipment, e.g., reclosers, fuses,);

Engineering Solutions

Goals/Targets/Requirements

Modeling;

Testing;
Characteristics of the loads;
Characteristics of the DG and/or energy storage units;
Characteristics of the power converter;
Integration and interconnection

Design of Islands

- Configurations and architectures
- Requirements for the DRIS
 - Steady state, transient,
- Requirements for DR
- Requirements for Area EPS
- Interconnect (disconnect/reconnect) system (includes dispatch functionality, etc.)

Operations of Islands

Semi-autonomous and autonomous operations;
Operation philosophies;
“Safety”;
Monitoring, information exchange and control

Miscellaneous

System impacts; DRIS agreements;

Annex A – Bibliography (e.g., Olson, Daley, ...

NEMA MG 1
EGSA
Color Books (e.g., IEEE gold book -reliability)
Marine Power System Requirements Std (Yuri/Basso)
IEEE Std 666
Grid Grounding (IEEE Std 80) C62.90.xxx
C62.21 – insulation levels fro grounding
NFPA 70 (NEC)
IEC (JCG DRES; TC64; from Koepfinger)

Annex B? – Example DR Island Applications?

Annex etc. as needed

Additional Topics for Consideration for P1547.4 (no definitive resolution decided)

Types of Islands

Classifications:

based on whether the island contains a portion of an area EPS or not?

Voltage levels

Storage or not

Technology types (sync, induction, inverter)

Generator types (wind, PV, diesel, renewable or not)

Critical or non-critical load (Loss of Load risk)

CA rule 21 classifications (size of DR as compared to line capability (rated load) it serves; fault contribution capability of DG vs fault tolerance of local/area EPS?)

Examples of DR Island Systems

facility microgrid (stand-alone)?

UPS?

“larger” island systems (a municipality with a portion of another Area EPS?)

DR Island System Includes at least one power source and load
(DRIS is an extension of Emergency System)

Need to look at how the DR technology impacts that load and vice versa
(do for each singular technology)

Consider multiples of same technology

Consider Permutations of DR technology mixes

Load characteristics

Consider each subclause of 1547 wrt this activity

General requirements

Voltage regulation

Frequency regulation

Grounding

Synchronization

Inadvertent energization of the area EPS

Monitoring

Isolation device
Protection from EMI
Surge withstand performance
Paralleling device

Response to (abnormal and normal) conditions
Response to local EPS faults
Response to load transitions
Area EPS reclosing coordination
Voltage
Frequency
Loss of synchronism
Reconnection to area EPS

Power Quality
Voltage
Frequency
Limitation of dc injection
Limitation of flicker induced by DR
Harmonics

Unintentional Islanding

Integration issues, e.g., volt regulation – within island as well as across “EPS”; transformers (and other equipment, e.g., reclosers, fuses,); frequency and voltage control; dispatch within the island; generation shedding; energy storage; seamless transfer vs shutdown and resync; stability (single and multigen); synchronous, inverter, induction based machines; grounding and neutrals; communications (MIC); power quality (transitions, ...); system protection; response to abnormal conditions; safety of units (DR, etc.); unintentional islanding (protection); load profile; load management; load sharing; load shedding; power transient; mechanical issues (noise, emissions, out of scope?); concerns; metering?; consider each subclause of 1547 wrt this activity; economic dispatch, e.g., pricing structure, etc.?; generation and system reliability; dynamics and (re)-configurability of Area EPS; interoperability of DR; blackstart;

4. P1547.4 Initial Outline/Table Of Contents

Introduction (... history of the standard, a description of its purpose,... 1547 series).

Introduction: Reasons for DRIS - reliability; maintenance; economic factors (peak shaving; deferred T&D; line/voltage support); power quality; power security (backup);

- 1. Overview (scope, purpose, use)**
- 2. References**
- 3. Definitions and Acronyms**
- 4. Basic functionality of the intended island**
- 5. General island performance guidelines**
- 6. Characteristics of loads**
- 7. Characteristics of DRs and interconnection systems**
- 8. Design, integration, and operations of islands**
 - Types of Islands
 - Engineering Concerns
 - Engineering Solutions
- 9. Etc.**

Annex A – Bibliography

Annex B? – Example DR Island Applications?

Annex etc. as needed

Notes of August 6, 2004

5. Basic Functionality of the Intended Island

EPS Connected Mode

- When EPS connected 1547 requirements apply
- Recognizing problems on EPS and disconnecting per 1547
- Coordination of disconnect criteria with EPS (intentional vs. EPS failure)
- Power import/export control
- Monitoring

Operational Mode Transition from EPS Connected Mode

- Identify transition requirements (based on load type, load dependent, do you need fast time based on load types?)
- Initiation Time
- Power Quality requirements during transition
- Identify transition types (seamless, within CBEMA, momentary make-before-break 100ms transfer, shutdown)
- Generation/ Load shed (capacity/load management)
- DR operation mode (current, voltage, power, VARS)

Island Mode

- Load Management (Can DR serve all loads?)
- Steady-State “Stability” control issues
- Multi-DR interaction
- DR operation mode (current, voltage, power, VARS)
- Power Quality requirements of loads during island
- Monitor EPS parameters
- Fuel limits
- Protection Issues (Fault protection)
- Blackstart
 - cold load pickup issues
 - DR limitations

Reconnection of Island to EPS

- Monitor EPS parameters
- Load Management
- System reconfiguration for synchronization (DR cannot reconnect without shutting down)
- Identify transition types (seamless, within CBEMA, momentary make-before-break 100ms transfer, shutdown)

6. Types of DR were discussed for consideration as starting points: see diagrams – Annex E of these P1547.4 Meeting Minutes.

P1547.4 Minutes Annex E: **DR Island System Types**

P1547.4 Draft Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power Systems

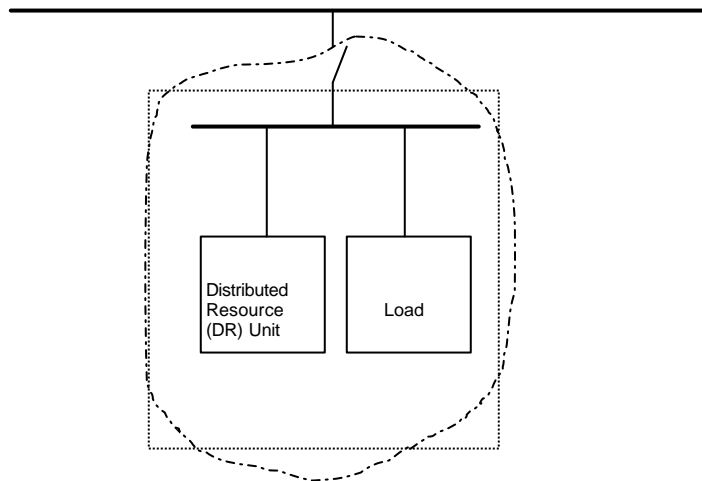
General Discussion: DR Island System Types

Chairperson: Ben Kroposki

Secretary: Tom Basso

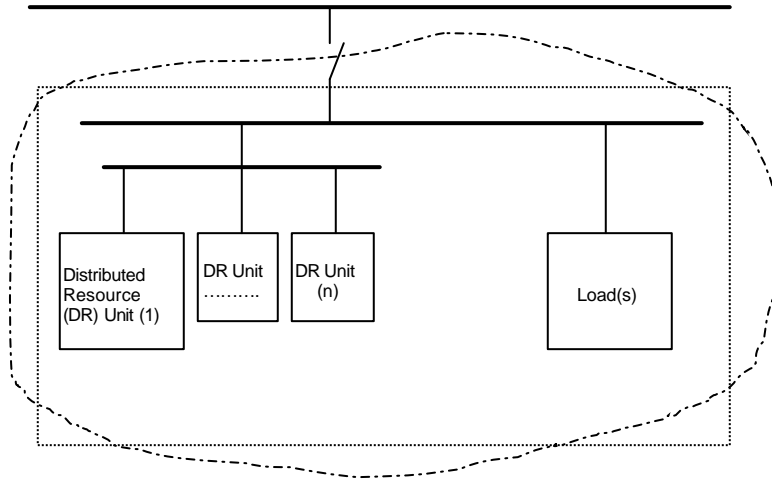
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1. DR Island System with Single DR, Single Load, Single point of connection to EPS



2

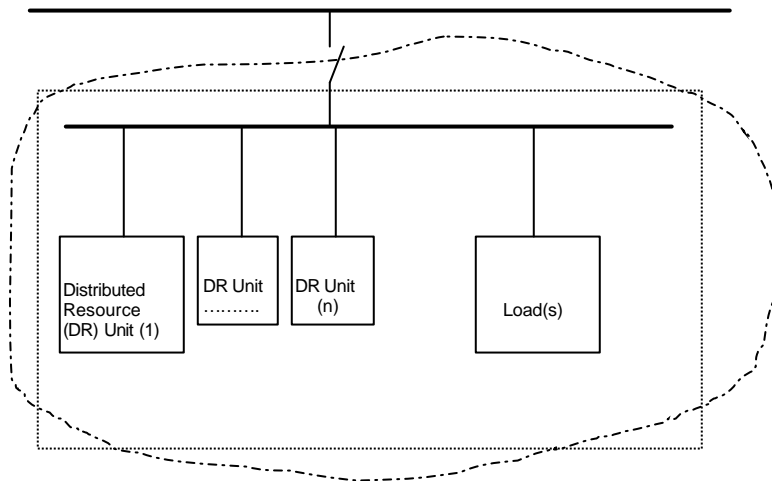
2a. DR Island System with multiple DR electrically connected to common but separate subbus, single load, single point of connection to EPS



DR responds as a single entity (aggregated DR controller)

3

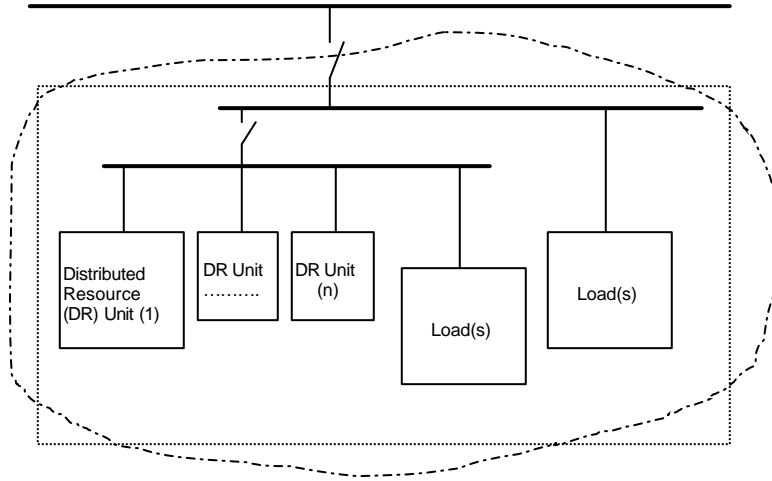
2b. DR Island System with multiple DR electrically connected to same bus, single load, single point of connection to EPS



Each DR responds independently

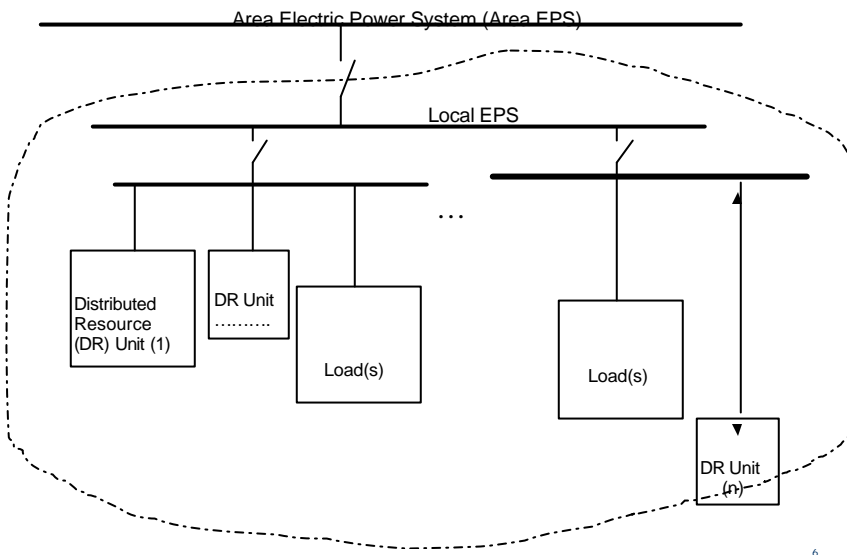
4

3. DR Island System with multiple DR electrically connected to common but separate subbus with loads, other loads on local EPS, single point of connection to EPS



5

4. DR Island System with multiple DRs and loads electrically separated by impedance from other DR and loads on local EPS, single point of connection to Area EPS



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