



Canadian Wind Interconnection Working Group (CWIWG)



Summary of CWIWG Inaugural Meeting

Toronto - June 9, 2006

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- John Kehler, Alberta Electric System Operator
- David Jacobson, Manitoba Hydro
- Bob Singh, Hydro One (Ontario)
- Rob Vance, Maritime Electric
- Scott Brown, New Brunswick System Operator
- Michel Tremblay, Hydro Quebec TransEnergie
- Charlie Smith, Utilities Wind Interest Group
- Steven Saylor, Vestas Americas
- Nigel Scott, Garrad Hassan

1. INTRODUCTION

This document provides a summary of the inaugural meeting of the Canadian Wind Interconnection Working Group (CWIWG), held on June 9, 2006 in Toronto. The objectives of this meeting were twofold:

- **Provide a networking forum for participants.** In the absence of a “FERC-like” national body it is difficult for parties involved in wind interconnection to learn about the activities of their counterparts in other jurisdictions. This meeting provided an opportunity for participants to inform others of their work, and to learn of related activities elsewhere.
- **Establish a mandate and workplan for the Working Group.** The group’s first task was to outline the CWIWG’s mandate and establish a workplan going forward. Will the CWIWG’s role be primarily as a coordinating body? Will the group take a pro-active approach to harmonize grid codes? How will it interact with U.S. entities such as NERC and FERC? Will it address wind integration issues? How will the group’s activities be supported? How often will it meet?

Appendix A provides a copy of the meeting agenda, Appendix B provides a list of participants and Appendix C provides a summary of the CanWEA Base Code. A summary of findings for both the morning and afternoon sessions is provided below.

2. MORNING SESSION – INFORMATION EXCHANGE

2.1 *Utility and System Operator Presentations*

During the morning presentations it was clear that provinces are currently in very different positions with respect to interconnection and wind integration.¹ Specifically:

- *Interconnection requirements.* Some system operators have wind-specific requirements in place, some apply standard generator requirements, while others are in the process of developing their requirements.
- *Current and future wind penetration levels.* Some system operators have a great deal of experience with wind integration and are looking to refine their methods through use of sophisticated tools such as forecasting. Others have little experience with wind, but are facing high wind penetration levels in the near future and therefore need to ramp up quickly.
- *Links to U.S.* Some system operators have either adopted U.S. regulations (e.g. FERC Orders), or are tied to reliability councils in the U.S. Others are completely independent of U.S. developments.

Appendix D provides copies of all presentations given in the morning and afternoon sessions.

¹ See the Garrad Hassan grid code report for details: http://www.canwea.ca/downloads/en/PDFS/Canadian_Grid_Code_for_Wind_Developments_-_Integrated_French-English_-_Final.pdf

2.2 *Utility and System Operator Needs and Concerns*

The group discussed two questions that will help shape the mandate of the CWIWG: “What are the key utility concerns in wind interconnection (safety, reliability, cost)?” and “What is most needed (information, studies, networking etc.) to assist system operators going forward?” This discussion brought out a wide range of concerns, focussed on *information, interconnection and integration* issues. The group highlighted the following as main needs and concerns in each area:

Information

- *Updates.* There is a marked interest in providing updates to utilities and system operators on current developments in Canadian jurisdictions (e.g. when a province develops interconnection requirements for wind) and in the United States (e.g. when there are proposed changes to the FERC grid code).

Wind Interconnection

- *Models.* Interest in development of generic, utility-validated models that can assist in system management (note that WECC is currently developing generic turbine models).
- *Fault Ride-Through.* Interest in coming to consensus on ride-through requirements for both high- and low-voltage faults.
- *Dynamic capability requirements.*
- *Transmission Reliability Margins (TRM).* Interest in analysing implications of wind on TRM.
- *Islanding.* Interest in examining islanding issue in terms of inertia and frequency regulation.

Wind Integration

- *Higher wind penetrations.* Interest in finding out more about wind penetrations greater than 5% or 10%: What are the issues? What is acceptable? What are added requirements?
- *Forecasting.* Gaining a better understanding of forecasting systems and how to use them.
- *Operator training.* Need for information and a better understanding of how to handle wind variability. Could be in the form of operator training, or a “Wind Toolkit” for utilities.
- *Extreme conditions.* How to deal with extreme environmental events such as freezing rain, heavy icing conditions, storms etc.

2.3 *Manufacturer Concerns*

The manufacturers’ presentation to the group is provided in Appendix D. Note that the manufacturers reemphasised their interest in seeing the development of harmonised requirements across jurisdictions. They also spoke of the need to pay attention to overlapping requirements where two apparently independent requirements can conflict, thereby making compliance extremely difficult and/or costly.

3. AFTERNOON SESSION – WORKPLAN FOR CWIWG

The afternoon session focused on CWIWG’s mandate, workplan and operations. Conclusions from this discussion are provided below.

3.1 CWIWG Mandate

The group agreed that CWIWG would serve a useful role as a voluntary, collaborative mechanism for utilities, system operators and others to facilitate technical issues related to wind development in Canada. The group indicated that CWIWG’s role would likely start out addressing “softer” issues (e.g. information exchange) and over time evolve into “harder” issues (e.g. addressing integration issues such as forecasting).

The group did not agree on a clear “mission statement” during the meeting – this will be firmed up at subsequent meetings. However, the following is proposed as a starting point for discussion:

“The mandate of CWIWG is to provide a Canadian forum for the voluntary exchange of technical information on wind interconnection and integration between utilities, system operators, manufacturers, developers and other stakeholders, and to facilitate uptake of wind through development of Best Practices on interconnection and wind integration.”

3.2 CWIWG Priorities and Workplan

There was general agreement that CWIWG should focus on the following priorities, in order:

- *Priority # 1 – Facilitate information exchange.* CWIWG will serve as a networking vehicle, primarily between utilities and system operators, with inputs from manufacturers, developers and other stakeholders, allowing them to meet, communicate, exchange information and keep abreast of each others’ efforts. The information exchange will be not only between provinces and territories, but also with related U.S. groups such as NERC, UWIG, WECC and AWEA. Participants noted that CWIWG should not seek to “reinvent the wheel”, but rather build on and complement the work being undertaken by these groups. This will be a near-term priority for CWIWG (0 to 6 months).
- *Priority # 2 – Work to harmonise interconnection requirements.* The group will focus on development of common rules, standards, and practices for Canadian requirements, and look at how these may be harmonised with each other, and with the emerging FERC grid code in the United States (includes influencing the FERC code if deemed appropriate). This will be a medium-term priority (3 to 12 months).
- *Priority # 3 – Explore areas of common interest in grid integration.* Recognising the different contexts of Canadian provinces and territories, the group will start by developing work priorities of common interest with respect to wind integration. As CWIWG’s mandate and working plan firm up, the group can then start to address these topics directly. This will be the group’s longer-term priority (12 to 36 months).

Participants proposed a series of activities that CWIWG may focus on. These are categorised according to the three priorities described above:

Priority # 1 Facilitate information exchange (near-term)

- **Task 1.1 Provide updates to CWIWG members.** News regarding developments on wind interconnection should be shared by e-mail among CWIWG members. This may be coordinated by CanWEA in the near term, until such time as a CWIWG secretariat (or other body) exists.
- **Task 1.2 Develop web site to post relevant documents.** Participants indicated that a web site would be a useful tool for CWIWG. The site should include relevant documents (e.g. the CanWEA Baseline Grid Code), notices of upcoming meetings, links to members of CWIWG etc. In the near term, CanWEA may be able to include such a page on its new website (anticipated launch: July '06)

Priority # 2 Work to harmonise interconnection requirements (medium-term)

- **Task 2.1 Monitor and react to developments in the U.S..** Participants indicated that CWIWG should be kept informed of grid code developments in NERC and FERC, and react appropriately if a proposed change impacts on Canadian jurisdictions. The group should also be kept informed of activities such as the WECC generic model development.
- **Task 2.2 Consider development of a “Best Practices Interconnection Toolbox”.** Participants indicated that despite their different contexts, there are a number of interconnection issues common to all participants. For these, CWIWG could work to develop “Best Practices” and minimum standards that help to harmonise grid codes across the provinces. These may constitute a “interconnection toolbox”, consisting of some or all of the following:
 - Common data submission forms
 - Common System Impact Study methodologies and reporting formats
 - Common Grid Code foundation (using CanWEA Base Code as the starting point)
 - Common testing and validation procedures
 - Common utility validated models

Priority # 3 Explore areas of common interest in grid integration (long-term)

- **Task 3.1 Develop list of potential projects.** Participants should develop a “long list” of potential study areas for CWIWG to focus on in the area of wind integration. This may include:
 - Studies on wind forecasting and the use of forecasting as a tool
 - Implications of high wind penetration (>10%) on grid operation
 - Training courses for system operators (e.g. dispatchers, load forecasters)
 - National study on wind integration (as opposed to province-by-province studies)
 - Assessing costs versus capability for what a wind farm can (and cannot) do
 - Assessing cost impacts of various grid interconnection requirements

3.3 CWIWG Administration

Participants provided the following views with respect to the set-up and operation of CWIWG:

- **Rules and protocols.** CWIWG will need to establish clear rules and protocols with respect to its activities (for example, a clear statement to the effect that the CWIWG is voluntary, and its findings are not binding on participants, utilities etc.)
- **Operating model.** Participants indicated that CWIWG should initially be facilitated by CanWEA until such time as it becomes an independent entity. There was great interest in having CWIWG eventually follow the operational model of the member-supported, non-profit Utility Wind Integration Group (UWIG) in the United States. There was some interest in potentially merging CWIWG within UWIG, but a number of participants felt that a Canadian forum with strong links to UWIG would be more appropriate. This is for reasons of size (the “Canadian voice” may be lost in a U.S. forum) and context (Canada’s regulatory regime is very different than the U.S.)
- **Funding.** It is expected that, once fully constituted, CWIWG will be supported by member contributions. However, in its early stages, it is hoped that CWIWG’s early activities will be supported by the federal government (e.g. Natural Resources Canada), CanWEA (as facilitator) and inputs from leading utilities.
- **Membership.** Participants indicated that CWIWG should be primarily focused on utilities and system operators, but should also include manufacturers, developers, equipment suppliers and other stakeholders. Note that utilities in the northern Territories should be invited to join CWIWG.
- **Links.** In the near term it will be important for CWIWG to establish strong links with counterparts in the U.S., including FERC, NERC and AWEA. The group may also seek an “endorsement” from these bodies to ensure that its work does not conflict.
- **Meeting frequency.** Participants indicated that CWIWG should initially meet 2 to 4 times per year. These meetings would take place face-to-face when there is an event that most participants are attending (e.g. annual CanWEA conference). Otherwise, meetings of the group should be by conference call.

4. NEXT STEPS

Below are the “next steps” for CWIWG:

Step One. Provide feedback on mandate and workplan of CWIWG. Members are asked to provide feedback **by July 21st 2006** on the mandate, workplan and administration put forward in the present document.

Step Two. Develop CWIWG network. CanWEA will take first steps to develop and facilitate the CWIWG network. This includes sharing of new developments (e.g. changes in FERC Order 661) with CWIWG members, development of a CWIWG page on the new CanWEA website and contact with relevant organisations (e.g. CEA, AWEA, FERC, NERC).

Step Three. Develop “Constitution” of CWIWG and secure early funding. Based on member feedback, CanWEA will develop a “Constitution” which outlines the group’s function and proposed membership structure and rates. This will be circulated among members – if warranted, the CWIWG may meet by teleconference to discuss and finalise this “Constitution”. At the same time, CanWEA will seek contributions to support CWIWG’s early operations from the federal government and members of CWIWG.

Step Four. Meet at CanWEA Conference. The next in-person meeting of CWIWG will take place at the CanWEA Conference in Winnipeg in October 2006 (likely in the afternoon of Sunday October 22, prior to the Conference opening reception). Below is a draft agenda for that meeting:

- Update on developments since inaugural meeting
- Review of CWIWG overall mandate and proposed workplan
- CWIWG administration and operations:
 - Rules and protocols
 - Membership structure and fees
 - Funding strategy
 - “Election” of CWIWG Chair (if necessary)
- CWIWG work items
 - Near-term
 - Long-term
- Next meeting

APPENDIX A -MEETING AGENDA

9:00 am Coffee and registration

Morning Session Objective: Provide a networking forum for participants. In the absence of a “FERC-like” national body it is difficult for parties involved in wind interconnection to learn about the activities of their counterparts in other jurisdictions. The morning session is intended to provide an opportunity for participants to inform others of their work, and to learn of related activities elsewhere.

9:15 am Introductions and Meeting Objectives (Sean Whittaker, CanWEA)

- Roundtable introductions
- Overview of the day’s objectives

9:30 am System Operator presentations

Review of provincial wind activity, system issues, study work, and connection rules and developments (10 min each + 5 min questions)

Jim Ko, British Columbia Transmission Corp.
John Kehler, Alberta Electric System Operator
David Jacobson, Manitoba Hydro
Bob Singh, Hydro One (Ontario)

10:30 Coffee Break

10:45 System Operator presentations (continued)

Rob Vance, Maritime Electric
Scott Brown, New Brunswick System Operator
Michel Tremblay, Hydro Quebec TransEnergie
Charlie Smith, Utilities Wind Interest Group – US perspectives

11:45 Open Discussion (chaired by John Kehler, AESO)

What are the key utility concerns in wind interconnection (safety, reliability, cost)?
What is most needed (information, studies, networking etc.) to assist system operators going forward?

12:30-13:15 Lunch break (lunch to be provided by CanWEA)

Afternoon Session Objective: Establish a mandate and workplan for the Working Group.
The Working Group's first task will be to outline the Working Group's mandate and establish a workplan going forward. Will the CWIWG's role be primarily as a coordinating body? Will the group take a pro-active approach to harmonize grid codes? How will it interact with U.S. entities such as NERC and FERC? Will it address wind integration issues? How will the group's activities be supported? How often will it meet?

13:15 Industry Perspectives

Wind industry perspective on interconnection, turbine and wind farm technology development and key issues (Steven W. Saylor, Chief Electrical Engineer, Vestas Americas)

CanWEA's work on common interconnection requirements – the Base Code (Nigel Scott, Garrad Hassan)

14:15 Discussion

Form two or three breakout groups - each group will be asked to discuss the following questions (one member of each group is assigned as a scribe):

CWIWG's Mandate:

- *What is the value of CWIWG?*
- *What should CWIWG's "mission statement" be?*
- *What should be its top (2 or 3) priorities?*

CWIWG Workplan:

- *What activities should CWIWG focus on in the near and long-term?*
- *What role could the Baseline Grid Code play?*
- *How should CWIWG interact with U.S. entities such as NERC and FERC?*
- *What are the next steps?*

CWIWG Operations:

- *How will the group's activities be supported?*
- *How often will it meet?*

15:15 Coffee Break

15:30 Report back to groups

Scribe from each group will report back to the plenary

16:00 Summary (Nigel Scott and Sean Whittaker)

APPENDIX B - MEETING PARTICIPANTS

Name	E-Mail	Organisation	Province
System Operators			
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APPENDIX C – CANWEA BASE CODE

The following requirements are those proposed for inclusion within the CanWEA Base Code. They consist of the following:

1. Frequency tolerance
2. Voltage tolerance
3. Power control
4. Reactive power capability/control
5. Voltage control
6. Frequency response
7. Low Voltage Ride Through (LVRT)
8. Power system stabilisers
9. Data Provision
10. Operational monitoring

The requirements also have the following characteristics:

- *Mandatory* indicates the requirement must be implemented.
- *Automatic access standard* indicates that, if met, the requirement will allow interconnection regardless of a) province, and b) site.
- *Reduced access standard* indicates a level less than automatic is allowable according to a) province, and b) site, subject to agreement with the relevant system operator.
- *Noted but not a requirement* implies a requirement is not enabled at present but may be in the future.

The following provides text format for the requirements in plain form, i.e. the detail and recommendations to CanWEA are not included.

C.1 FREQUENCY TOLERANCE

Frequency tolerance is a mandatory requirement. The requirement is for:

1. Continuous normal operation between 59.4Hz and 60.6Hz.
2. Under-frequency time based capability.
3. Over frequency time based capability.

C.2 VOLTAGE TOLERANCE

Voltage tolerance is a mandatory requirement. The requirement is for:

1. Continuous normal operation between +10% and -10% of nominal voltage at the interconnection point (high voltage side of transformer). Note that in Northern Ontario this range may be exceeded.

2. Over-voltage time based capability.
3. Under-voltage time based capability.

C.3 POWER CONTROL

Power control, including the capability to limit maximum power output and control ramp rates, is useful and desirable but not a requirement. It is likely to become a requirement for new projects further in the future as wind penetration starts to become high.

C.4 REACTIVE POWER CONTROL/CAPABILITY

Reactive capability is a requirement but is allowed to vary by a) province, and b) site. The requirement is as follows:

1. Reactive capability at full output.

A capability providing 0.90 lagging to 0.95 leading at full MW output, and meeting the further requirements of reactive capability as set out below will allow automatic interconnection regardless of a) province or b) site specific conditions.

If a reduced capability is sought then this is to be determined by the following:

a) In accordance with provincial rules.

b) In accordance with the findings of System Impact Studies developed for the specific site and which show the actual maximum capability that is required.

The intention of this clause is to allow the actual reactive capability to be varied according to actual requirements. Variation according to a) or b) should be agreed with the system operator.

2. Reactive capability at reduced output.

A capability providing reactive power up to the power factors 0.90 lagging to 0.95 leading throughout the power output range, and meeting the further requirements of reactive capability as set out herein will allow automatic interconnection regardless of a) province or b) site specifics. In addition to this the wind farm should offer a capability beyond this to the system operator if reasonably available through the turbines.

If a reduced capability is sought then this is to be determined by the following:

a) In accordance with provincial rules.

b) In accordance with the findings of System Impact Studies developed for the specific site and which show the actual maximum capability that is required.

The intention of this clause is to allow the reactive capability at reduced MW loading to be varied according to actual requirements. Variation according to a) or b) should be agreed with the system operator.

It should be noted that Québec currently requires the MVAr defined by 0.95 lead to 0.95 lag power factor at full MW load to be available throughout the MW output range.

3. Dynamic reactive capability.

Subject to the findings of 1a) and 1b), at least a portion of the reactive capability should be dynamic. The control system for the reactive capability should provide that the dynamic capability is always available such that the provided capability at the point of interconnection appears to the system operator as similar to either a synchronous machine or a dynamic reactive device and hence is capable of meeting any dynamic reactive requirements most notably in regards to voltage control.

4. Balance of reactive sources.

It is wholly satisfactory to provide all or part of the reactive power capability from the turbines or separate reactive devices located within the wind farm provided the other requirements pertaining to reactive capability are met. In some cases this may extend to reactive compensation devices on the system operator's network where this has been identified as a solution and agreed with the system operator.

5. All reactive capabilities are defined at the point of interconnection. This is normally the high voltage side of the main grid transformer. It is noted that Alberta currently defines the requirements on the lower voltage side of the main grid transformer.

C.5 VOLTAGE CONTROL

Voltage control is a requirement but is allowed to vary according to a) province, and b) site. The requirement is as follows:

1. Voltage Control at the point of interconnection (or otherwise agreed) is a requirement. If the control is fully capable of utilising the agreed reactive capability of the project defined elsewhere then interconnection is automatic regardless of a) province, and b) site specifics.

A reduced requirement for voltage control may be sought in accordance with the following:

a) Provincial rules.

b) The findings of System Impact Studies developed for the specific site and which show the actual maximum capability that is required.

It should be noted that either a) or b) may define a reduced requirement which may in some circumstances become no requirement at all.

The intention of this clause is to allow the actual required voltage control capability to be varied according to requirements. This voltage control requirement must be related back to reactive capability requirements. Variation according to a) or b) should be agreed with the system operator.

C.6 FREQUENCY RESPONSE

Frequency response is not a requirement. It may become a requirement for new projects further in the future as wind penetration starts to become high.

C.7 LOW VOLTAGE RIDE THROUGH

LVRT is a mandatory requirement but is allowed to vary according to a) province, and b) site. The requirement is as follows:

1. A LVRT capability defined at the point of interconnection (normally defined as the high voltage side of the grid connection transformer) and meeting or exceeding that shown – that is to remain connected for voltages reduced to 0% for up to 0.15s, thereafter followed by a linear recovery to 85% voltage after 3s – shall be allowed automatic interconnection regardless of a) province or b) site. The capability is shown in the following figure.

A reduced requirement for LVRT may be sought in accordance with the following:

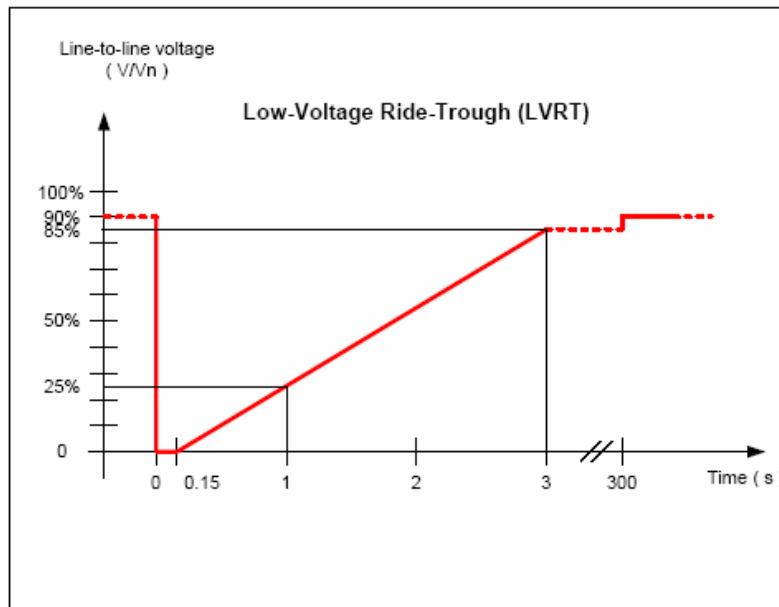
a) Provincial rules.

b) The findings of System Impact Studies developed for the specific site and which show the actual maximum capability that is required.

It should be noted that either a) or b) may define a reduced requirement which may in some circumstances become no requirement at all.

The intention of this clause is to allow the actual required LVRT capability to be varied according to requirements. Variation according to a) or b) should be agreed with the system operator.

2. It is noted that LVRT may require tolerance to significant negative phase sequence for short periods and the plant should be capable of this. Item 1 applies primarily to voltage depressions under balanced phase conditions.



Note: Positive sequence voltage at the fundamental frequency

C.8 POWER SYSTEM STABILISERS

The inclusion of a Power System Stabiliser is not a requirement. It may become a requirement for new projects further in the future as wind penetration starts to become high.

C.9 INFORMATION PROVISION

The following data provision clauses are mandatory requirements as applicable.

1. Planning and anticipated operational data. Technical data will be provided to the system operator, generally in advance of connection and during application for interconnection. The required data will encompass the technical and anticipated operational characteristics of the plant in detail suitable for System Impact Studies. The System Operator will provide the information pro forma upon request.
2. Wind Turbine model. As part of item 1, the project will need to submit a detailed simulation model of the wind turbine(s) to be used in either PSS/E or PSLF format. The model shall be one that is approved by the “AWEA/CanWEA/System Operator modelling group”.
3. Submission of an application for interconnection with preliminary data only, but with initial fees to secure registration and queue placement, is allowable. In such a case the project developer is allowed access to system data to self study the interconnection and advise the system operator appropriately to gain an interconnection schedule of works and date for interconnection. Subsequent to completion of the wind farm design and

turbine selection, the project will submit the full requirements of item 1 and 2 to the system operator for assessment, and will be liable for any inaccuracies through the self study process.

This clause is intended to ease the issues of timing with data provision and connection. This clause is enabled only by consent of the system operator once the above process is approved.

4. The completed wind farm, once interconnected, will be subject to compliance testing to physically demonstrate the wind farm performance meets that of the Code. Agreement on testing is being sought and this clause is not currently enabled.

C.10 OPERATIONAL MONITORING

The provision of operational monitoring is mandatory.

1. Projects should liaise with the relevant system operator and expect to provide at least some of the following data through real time communications:
 - MW import and export
 - MVAr import and export
 - Voltage
 - Wind speed and direction
 - Site temperature
 - Status of circuit breakers and/or switches
 - Number of turbines available/unavailable

Other data transmission may be required to be agreed on a) a provincial basis, and b) a site specific basis.

2. In addition to the above data the wind farm should expect to provide at least one automatic channel whereby control commands issued by the system operator can be received and acted upon. The requirements of the control channels and interface are to be agreed on a) a provincial basis, and b) a site specific basis.

APPENDIX D - PRESENTATIONS

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