

3. 第3回検証委員会 参考資料

(データ諸元)

- ・ 苫東厚真1号機 脱気器・ドラム水位など運転データ (2s データ_3
時0分~30分) <…4975~4987ページ>

URL (PDF) :

苫東厚真1号機脱気器・ドラム水位など運転データ (2s データ_3時0分~30分)

http://www.oceto.or.jp/iinkai/hokkaido_kensho/hokkaido_kensho_03_data1.pdf

URL (Excel) :

該当ファイルにつき下記ページ下部よりダウンロードください。

http://www.oceto.or.jp/iinkai/hokkaido_kensho/hokkaido_kensho_3_shiryo.html

苫東厚真1号機 脱気器・ドラム水位など運転データ

第3回平成30年北海道胆振東部地震に伴う
大規模停電に関する検証委員会 データ提供

| 単位 | cm | MPa | % | mm |
|-------------------------|-------|-------|--------------|-----------|
| | 脱気器水位 | 主蒸気圧力 | 加減弁開度（カム軸位置） | ドラム水位（平均） |
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| 2018/09/06 03:00:12.000 | 292.1 | 16.60 | 87.5 | 15 |
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| 2018/09/06 03:00:18.000 | 292.2 | 16.63 | 87.4 | 7 |
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| 2018/09/06 03:00:36.000 | 292.6 | 16.63 | 87.5 | 2 |
| 2018/09/06 03:00:38.000 | 292.6 | 16.63 | 87.5 | 7 |
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| 2018/09/06 03:25:44.000 | 80.9 | 16.50 | -9.1 | -338 |
| 2018/09/06 03:25:46.000 | 80.7 | 16.49 | -9.1 | -348 |
| 2018/09/06 03:25:48.000 | 80.7 | 16.49 | -9.1 | -361 |
| 2018/09/06 03:25:50.000 | 80.7 | 16.49 | -9.1 | -381 |
| 2018/09/06 03:25:52.000 | 80.7 | 16.50 | -9.1 | -412 |
| 2018/09/06 03:25:54.000 | 80.6 | 16.49 | -9.1 | -430 |
| 2018/09/06 03:25:56.000 | 80.6 | 16.49 | -9.1 | -446 |
| 2018/09/06 03:25:58.000 | 80.8 | 16.50 | -9.1 | -452 |
| 2018/09/06 03:26:00.000 | 80.9 | 16.48 | -9.1 | -453 |
| 2018/09/06 03:26:02.000 | 81.0 | 16.48 | -9.1 | -450 |
| 2018/09/06 03:26:04.000 | 81.1 | 16.47 | -9.1 | -444 |
| 2018/09/06 03:26:06.000 | 80.9 | 16.47 | -8.1 | -436 |
| 2018/09/06 03:26:08.000 | 80.9 | 16.47 | -8.3 | -428 |
| 2018/09/06 03:26:10.000 | 81.1 | 16.47 | -8.6 | -426 |
| 2018/09/06 03:26:12.000 | 81.2 | 16.47 | -8.8 | -429 |
| 2018/09/06 03:26:14.000 | 81.2 | 16.47 | -9.0 | -447 |
| 2018/09/06 03:26:16.000 | 81.2 | 16.47 | -9.1 | -457 |
| 2018/09/06 03:26:18.000 | 81.2 | 16.48 | -9.1 | -462 |
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| 2018/09/06 03:26:22.000 | 81.5 | 16.48 | -9.1 | -469 |
| 2018/09/06 03:26:24.000 | 81.8 | 16.48 | -9.1 | -469 |
| 2018/09/06 03:26:26.000 | 81.8 | 16.48 | -9.1 | -470 |
| 2018/09/06 03:26:28.000 | 81.8 | 16.47 | -9.1 | -470 |
| 2018/09/06 03:26:30.000 | 81.9 | 16.48 | -9.1 | -471 |
| 2018/09/06 03:26:32.000 | 82.0 | 16.48 | -9.1 | -470 |
| 2018/09/06 03:26:34.000 | 82.1 | 16.47 | -9.1 | -470 |
| 2018/09/06 03:26:36.000 | 82.2 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:26:38.000 | 82.4 | 16.46 | -9.1 | -471 |
| 2018/09/06 03:26:40.000 | 82.5 | 16.45 | -9.1 | -470 |
| 2018/09/06 03:26:42.000 | 82.5 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:26:44.000 | 82.5 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:26:46.000 | 82.6 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:26:48.000 | 82.9 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:26:50.000 | 83.0 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:26:52.000 | 83.0 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:26:54.000 | 83.0 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:26:56.000 | 83.0 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:26:58.000 | 83.1 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:27:00.000 | 83.2 | 16.45 | -9.1 | -472 |
| 2018/09/06 03:27:02.000 | 83.3 | 16.45 | -9.1 | -472 |
| 2018/09/06 03:27:04.000 | 83.4 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:27:06.000 | 83.3 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:27:08.000 | 83.4 | 16.45 | -9.1 | -472 |
| 2018/09/06 03:27:10.000 | 83.5 | 16.45 | -9.1 | -472 |
| 2018/09/06 03:27:12.000 | 83.5 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:27:14.000 | 83.6 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:27:16.000 | 83.6 | 16.45 | -9.1 | -471 |

| | | | | |
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| 2018/09/06 03:27:20.000 | 83.8 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:27:22.000 | 83.8 | 16.46 | -9.1 | -471 |
| 2018/09/06 03:27:24.000 | 83.9 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:27:26.000 | 83.9 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:27:28.000 | 83.9 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:27:30.000 | 84.0 | 16.45 | -9.1 | -471 |
| 2018/09/06 03:27:32.000 | 84.0 | 16.45 | -9.1 | -472 |
| 2018/09/06 03:27:34.000 | 84.2 | 16.47 | -9.1 | -471 |
| 2018/09/06 03:27:36.000 | 84.2 | 16.45 | -9.1 | -472 |
| 2018/09/06 03:27:38.000 | 84.2 | 16.47 | -9.1 | -472 |
| 2018/09/06 03:27:40.000 | 84.2 | 16.47 | -9.1 | -472 |
| 2018/09/06 03:27:42.000 | 84.3 | 16.47 | -9.1 | -471 |
| 2018/09/06 03:27:44.000 | 84.2 | 16.47 | -9.1 | -471 |
| 2018/09/06 03:27:46.000 | 84.3 | 16.47 | -9.1 | -472 |
| 2018/09/06 03:27:48.000 | 84.3 | 16.47 | -9.1 | -472 |
| 2018/09/06 03:27:50.000 | 84.3 | 16.48 | -9.1 | -472 |
| 2018/09/06 03:27:52.000 | 84.3 | 16.48 | -9.1 | -472 |
| 2018/09/06 03:27:54.000 | 84.4 | 16.47 | -9.1 | -471 |
| 2018/09/06 03:27:56.000 | 84.4 | 16.47 | -9.1 | -471 |
| 2018/09/06 03:27:58.000 | 84.4 | 16.48 | -9.1 | -472 |
| 2018/09/06 03:28:00.000 | 84.5 | 16.47 | -9.1 | -471 |
| 2018/09/06 03:28:02.000 | 84.4 | 16.48 | -9.1 | -472 |
| 2018/09/06 03:28:04.000 | 84.7 | 16.47 | -9.1 | -471 |
| 2018/09/06 03:28:06.000 | 84.7 | 16.47 | -9.1 | -472 |
| 2018/09/06 03:28:08.000 | 84.7 | 16.47 | -9.1 | -472 |
| 2018/09/06 03:28:10.000 | 84.8 | 16.47 | -9.1 | -471 |
| 2018/09/06 03:28:12.000 | 84.7 | 16.47 | -9.1 | -472 |
| 2018/09/06 03:28:14.000 | 84.8 | 16.47 | -9.1 | -471 |
| 2018/09/06 03:28:16.000 | 84.8 | 16.48 | -9.1 | -472 |
| 2018/09/06 03:28:18.000 | 84.8 | 16.50 | -9.1 | -472 |
| 2018/09/06 03:28:20.000 | 84.9 | 16.48 | -9.1 | -471 |
| 2018/09/06 03:28:22.000 | 84.8 | 16.47 | -9.1 | -472 |
| 2018/09/06 03:28:24.000 | 84.9 | 16.50 | -9.1 | -472 |
| 2018/09/06 03:28:26.000 | 84.9 | 16.49 | -9.1 | -472 |
| 2018/09/06 03:28:28.000 | 84.8 | 16.50 | -9.1 | -472 |
| 2018/09/06 03:28:30.000 | 84.8 | 16.50 | -9.1 | -472 |
| 2018/09/06 03:28:32.000 | 84.9 | 16.49 | -9.1 | -472 |
| 2018/09/06 03:28:34.000 | 84.9 | 16.49 | -9.1 | -471 |
| 2018/09/06 03:28:36.000 | 84.8 | 16.49 | -9.1 | -471 |
| 2018/09/06 03:28:38.000 | 84.9 | 16.50 | -9.1 | -472 |
| 2018/09/06 03:28:40.000 | 84.9 | 16.50 | -9.1 | -471 |
| 2018/09/06 03:28:42.000 | 84.9 | 16.50 | -9.1 | -471 |
| 2018/09/06 03:28:44.000 | 84.9 | 16.50 | -9.1 | -471 |
| 2018/09/06 03:28:46.000 | 84.9 | 16.50 | -9.1 | -472 |
| 2018/09/06 03:28:48.000 | 84.9 | 16.50 | -9.1 | -472 |
| 2018/09/06 03:28:50.000 | 84.9 | 16.49 | -9.1 | -471 |
| 2018/09/06 03:28:52.000 | 85.1 | 16.50 | -9.1 | -471 |
| 2018/09/06 03:28:54.000 | 85.1 | 16.49 | -9.1 | -471 |
| 2018/09/06 03:28:56.000 | 85.1 | 16.49 | -9.1 | -472 |
| 2018/09/06 03:28:58.000 | 85.1 | 16.49 | -9.1 | -471 |
| 2018/09/06 03:29:00.000 | 85.1 | 16.50 | -9.1 | -471 |
| 2018/09/06 03:29:02.000 | 84.9 | 16.50 | -9.1 | -471 |
| 2018/09/06 03:29:04.000 | 85.1 | 16.49 | -9.1 | -471 |
| 2018/09/06 03:29:06.000 | 85.1 | 16.49 | -9.1 | -471 |
| 2018/09/06 03:29:08.000 | 85.1 | 16.49 | -9.1 | -472 |
| 2018/09/06 03:29:10.000 | 85.1 | 16.49 | -9.1 | -471 |
| 2018/09/06 03:29:12.000 | 85.1 | 16.49 | -9.1 | -471 |
| 2018/09/06 03:29:14.000 | 85.1 | 16.50 | -9.1 | -471 |
| 2018/09/06 03:29:16.000 | 85.1 | 16.50 | -9.1 | -471 |
| 2018/09/06 03:29:18.000 | 85.1 | 16.49 | -9.1 | -471 |
| 2018/09/06 03:29:20.000 | 85.0 | 16.49 | -9.1 | -472 |
| 2018/09/06 03:29:22.000 | 85.0 | 16.52 | -9.1 | -472 |
| 2018/09/06 03:29:24.000 | 85.1 | 16.51 | -9.1 | -472 |
| 2018/09/06 03:29:26.000 | 85.1 | 16.52 | -9.1 | -472 |
| 2018/09/06 03:29:28.000 | 85.0 | 16.52 | -9.1 | -473 |
| 2018/09/06 03:29:30.000 | 85.0 | 16.52 | -9.1 | -472 |
| 2018/09/06 03:29:32.000 | 85.1 | 16.52 | -9.1 | -472 |
| 2018/09/06 03:29:34.000 | 84.9 | 16.52 | -9.1 | -472 |
| 2018/09/06 03:29:36.000 | 85.0 | 16.52 | -9.1 | -473 |
| 2018/09/06 03:29:38.000 | 85.1 | 16.52 | -9.1 | -473 |
| 2018/09/06 03:29:40.000 | 84.9 | 16.52 | -9.1 | -471 |
| 2018/09/06 03:29:42.000 | 85.0 | 16.52 | -9.1 | -471 |
| 2018/09/06 03:29:44.000 | 85.0 | 16.52 | -9.1 | -471 |
| 2018/09/06 03:29:46.000 | 84.9 | 16.52 | -9.1 | -472 |

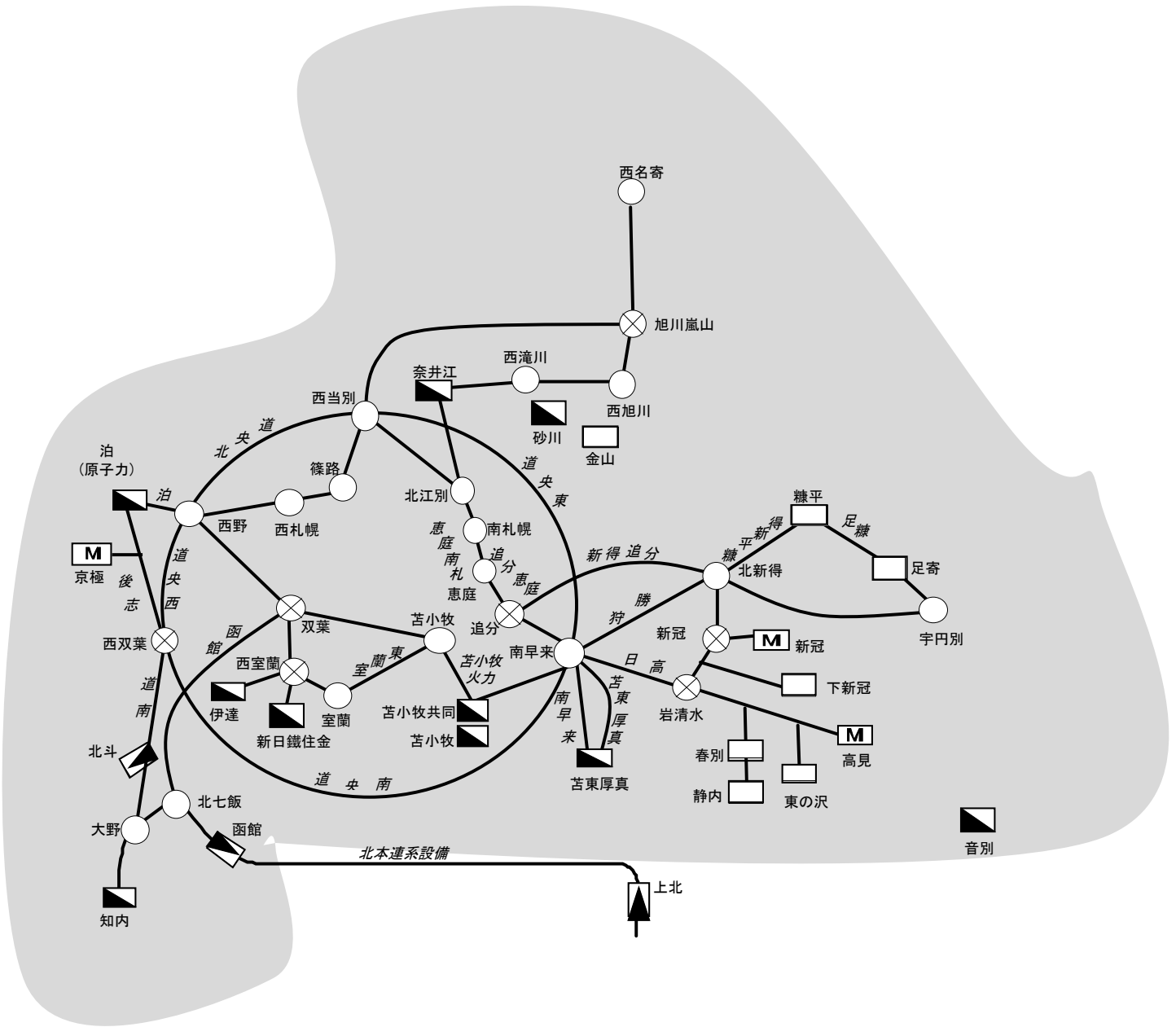
| | | | | |
|-------------------------|------|-------|------|------|
| 2018/09/06 03:29:48.000 | 84.9 | 16.52 | -9.1 | -472 |
| 2018/09/06 03:29:50.000 | 84.9 | 16.52 | -9.1 | -473 |
| 2018/09/06 03:29:52.000 | 84.9 | 16.52 | -9.1 | -472 |
| 2018/09/06 03:29:54.000 | 84.8 | 16.51 | -9.1 | -472 |
| 2018/09/06 03:29:56.000 | 84.8 | 16.51 | -9.1 | -471 |
| 2018/09/06 03:29:58.000 | 84.8 | 16.52 | -9.1 | -471 |
| 2018/09/06 03:30:00.000 | 84.7 | 16.52 | -9.1 | -473 |

補足資料一覧

< . . . 4988~4999ページ >

- ・ 北海道電力管内電力系統図（概要）
- ・ 系統運用に関する基本用語の解説

北海道電力管内電力系統図（概要）

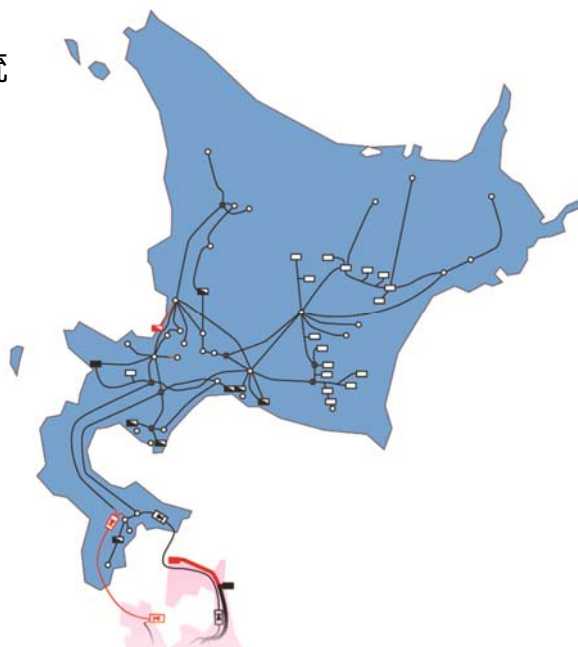


系統運用に関する基本用語の解説

①系統・②基幹系統

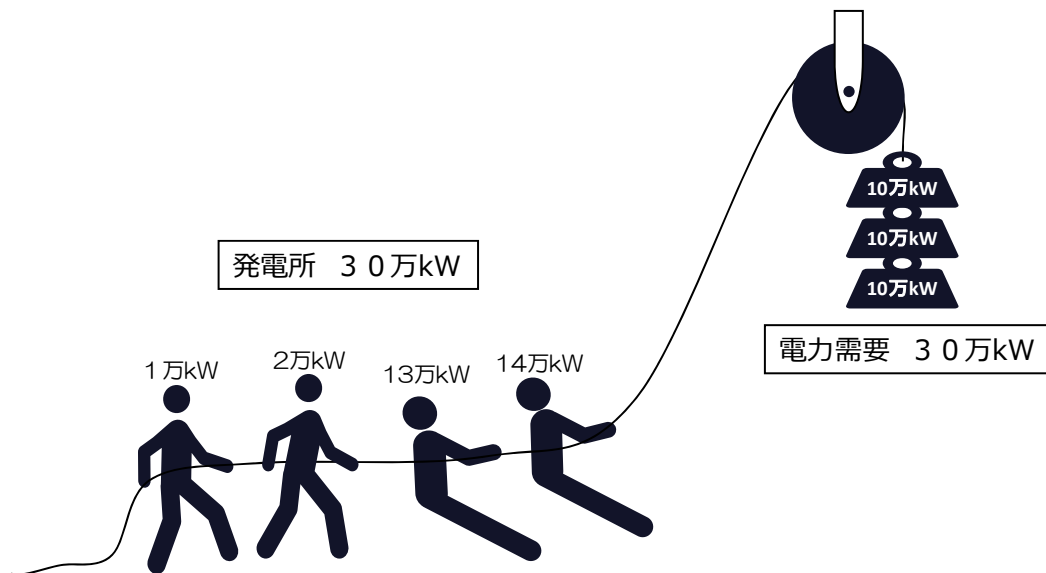
- 電力を供給する送電線は、効率的に電気を送るため、電圧を変えて電気を送ります。この電気を送る電力網を『**系統**』といいます。最も高い電圧で長距離の送電線を『**基幹系統**』といいます。北海道の場合、基幹系統は「275kV、187kV」の送電線になります。
- これら基幹送電線から変電所で電圧を下げ、電気を使う需要家に送られています。

北海道電力管内の基幹系統



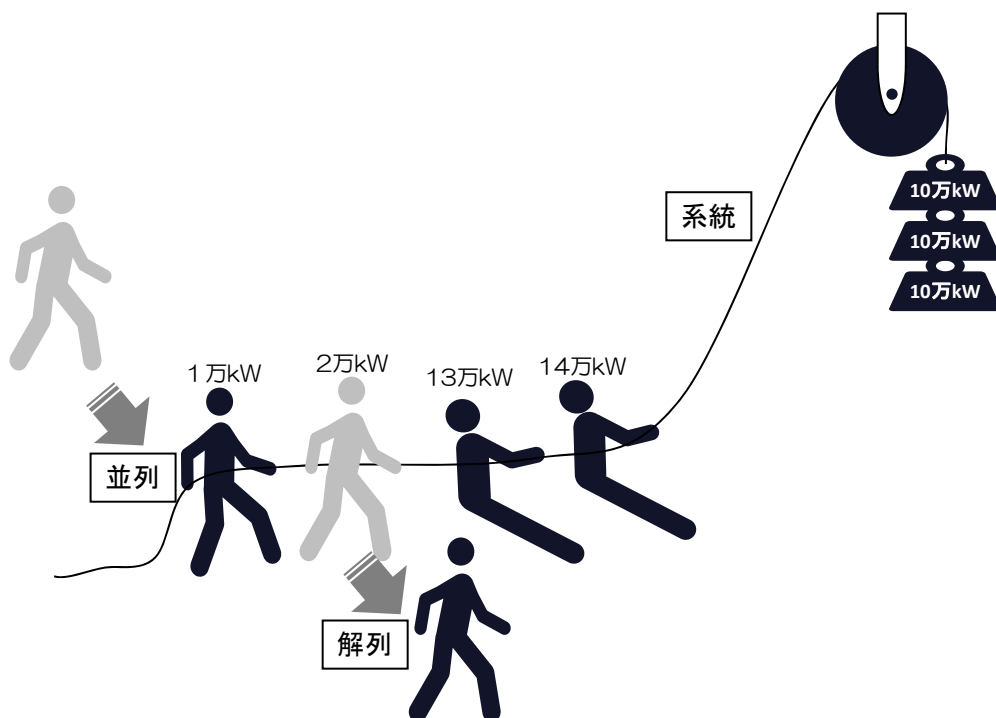
③同時同量

- 下の図は「需要」をおもりに、発電所（電源）を人、送電線をロープに見立て複雑な系統図を模式的に示したものです。
- 電気は貯めることができないため、常に需要増減に合わせてと発電する電気の量を『**同時同量**』でバランスさせています。



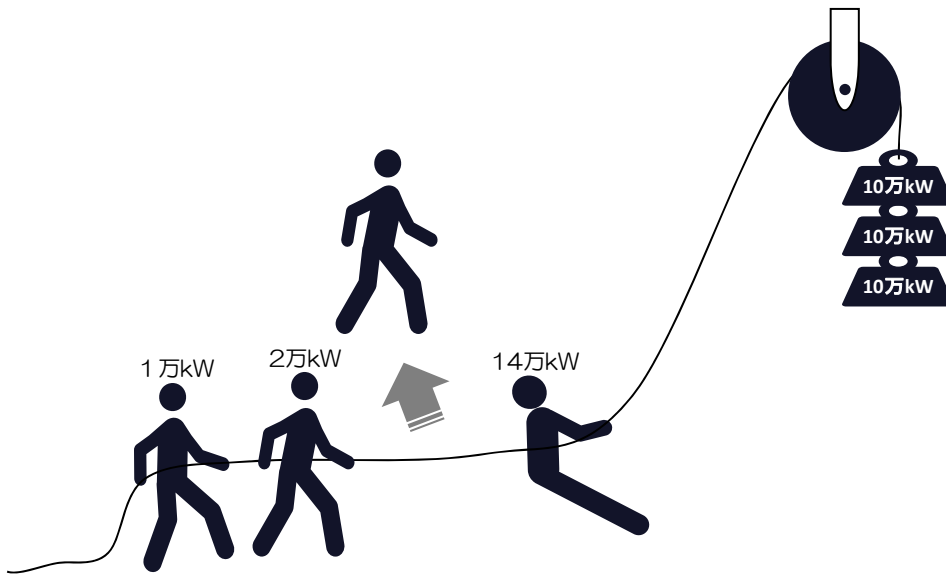
④並列・⑤解列

- 発電所（電源）が系統につながり電気を送れる状態を『**並列**』、系統から切り離された状態を『**解列**』といいます。なお、解列状態にある火力発電機等は、運転再開までに時間を要します。



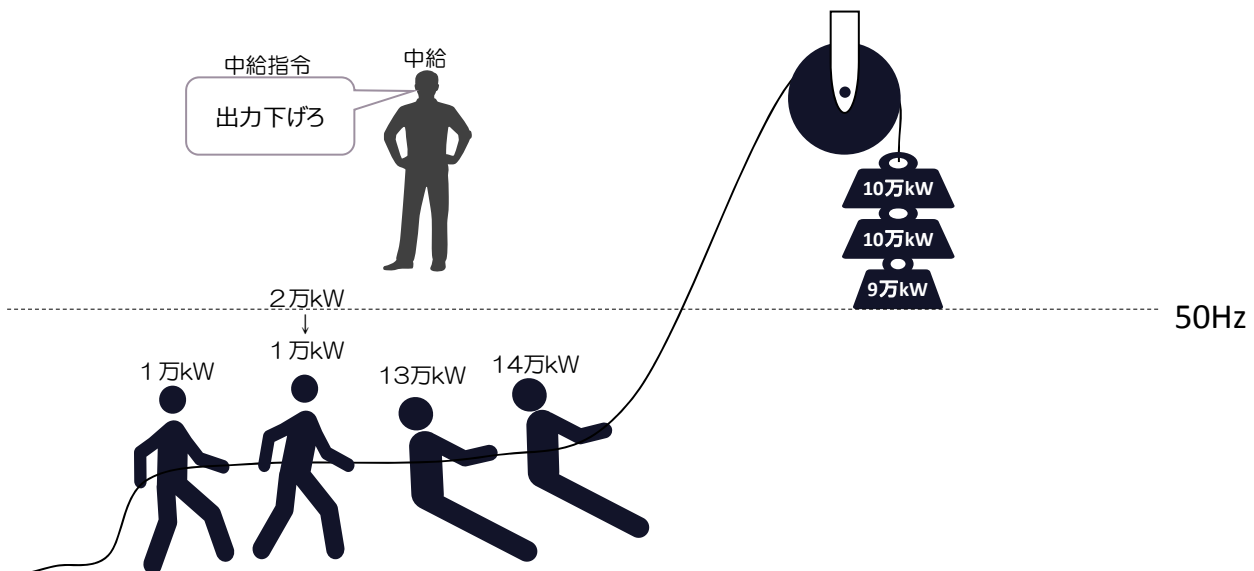
⑥（発電機）トリップ

- 発電機やシステムの異常を保護装置により検出した場合、保護装置により発電機等のしゃ断器を動作（『トリップ』）させ、電力供給をストップさせることで、発電機の損傷などを防ぎます。
- こうすることで、発電機が停止したとしても、早く復帰することとができるためです。



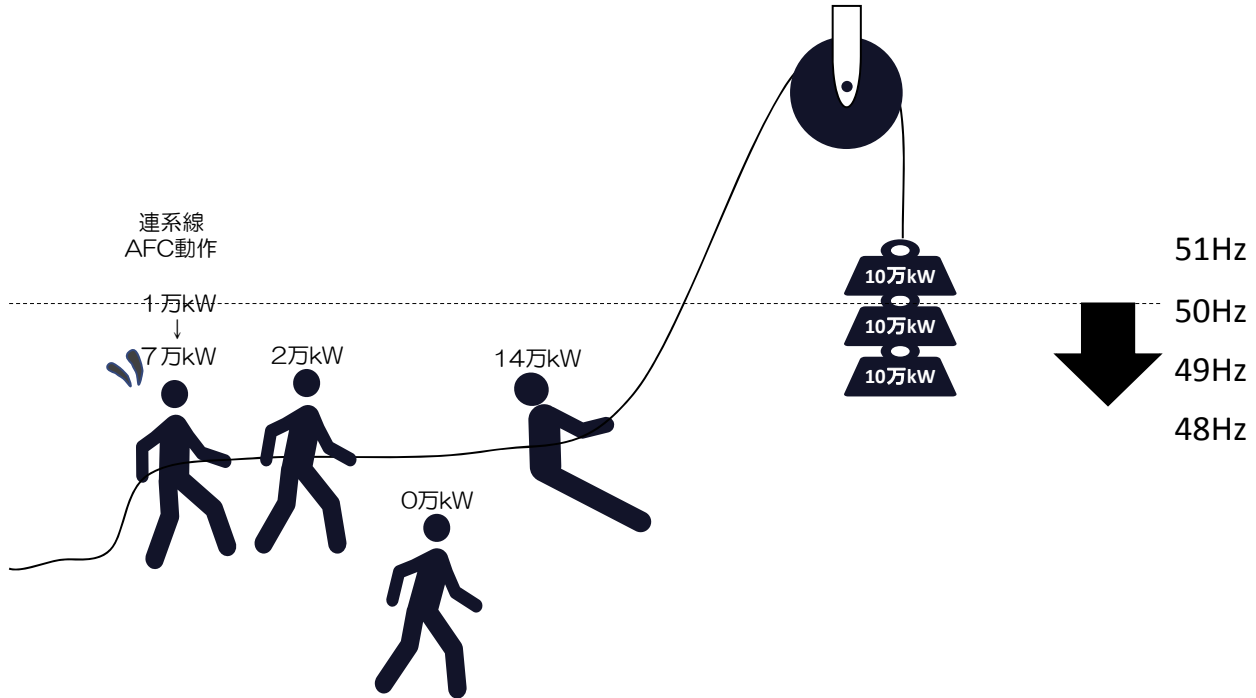
⑦周波数・⑧中央給電指令所（中給）

- 系統運用において『周波数』は『同時同量』を表すために重要な値です。周波数は北海道であれば50Hzであり、需要と供給のバランスが崩れると周波数が上下します。
- 絵のようにおもりの高さを維持するように電力需要の量に応じて、『中央給電指令所（中給）』が大きな発電所に発電の量の指令を出し周波数を一定（＝同時同量）に保ちます。



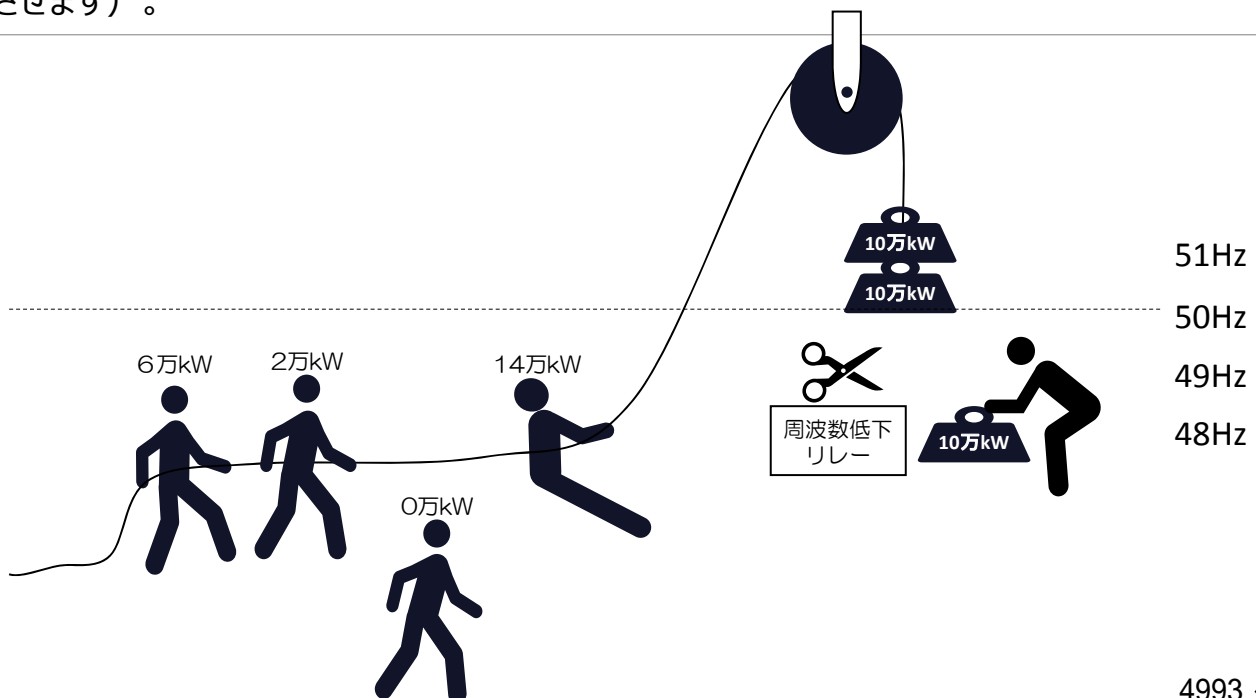
⑨連系線、北本・⑩自動周波数制御装置 (Auto Frequency Control)

- 事故などで大きな発電所が停止した場合、需要を支えられず、急激に周波数低下が起こります。
- このときに即時に動作するのは、隣のエリアと供給エリアがつながっている送電線の『**連系線**』です。連系線にある『**自動周波数制御装置 (AFC)**』が動作し、隣のエリアの電力を流し需要を支えようとします。北海道と本州をつなぐ連系線を『**北本連系線 (連系設備)**』と呼ばれています。



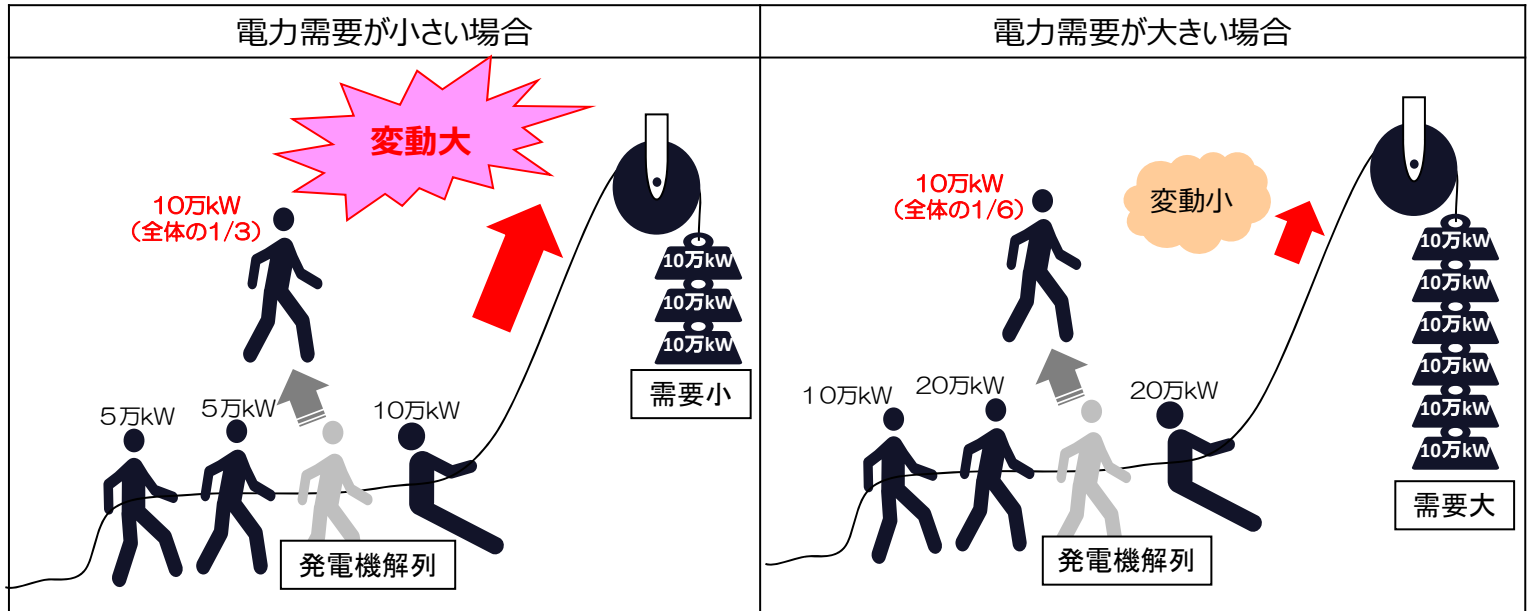
⑪整定値・⑫リレー・周波数低下リレー (Under Frequency Relay)

- 発電側の発電量（供給力）が足りず、周波数低下が一定時間、一定周波数（『**整定値**』）以下となった場合には、『**周波数低下リレー (UFR)**』が動作します。
- 『**リレー**』は定めた条件で自動で発電機や負荷（需要）などを系統から切り離す装置であり、周波数低下リレー (UFR) による負荷遮断では、一定量の負荷（需要）を切り離します（停電させます）。



⑬ 発電機解列に伴う周波数変動の大きさ

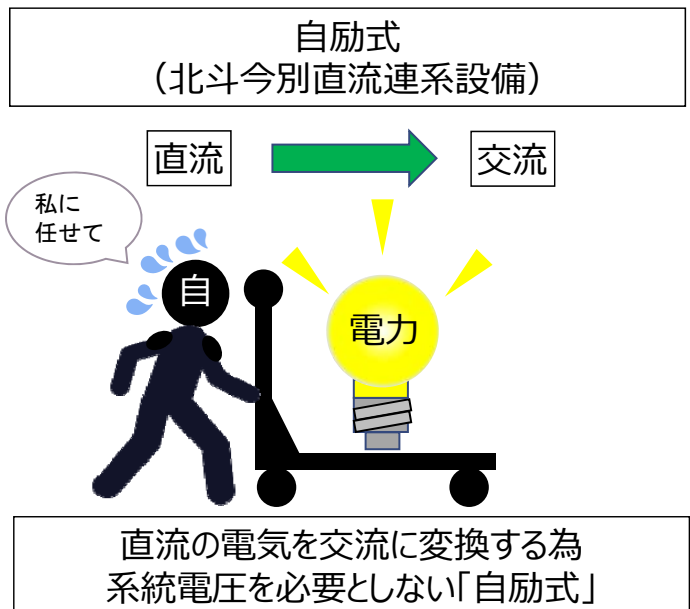
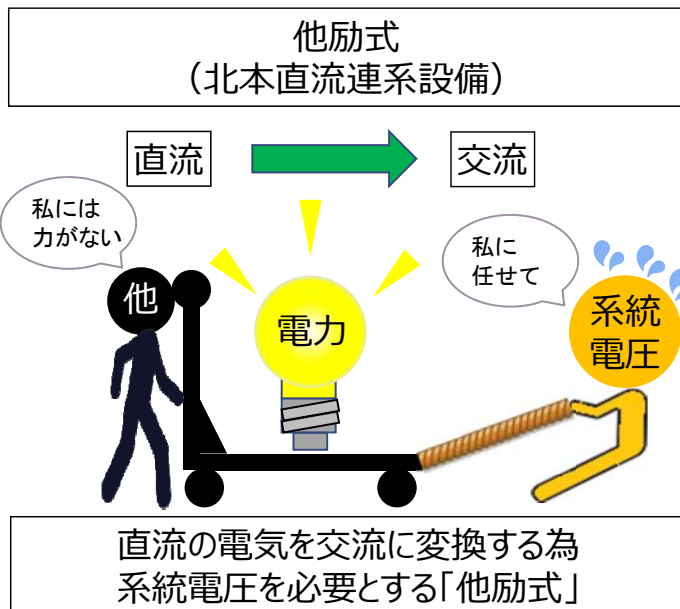
- 電気は貯めることができないため、常に需要増減に合わせて発電する電気の量を『同時同量』でバランスさせています。
- しかし、発電機や系統の異常を保護装置により検出した場合、保護装置により発電機等のしゃ断器を動作させ、『発電機を解列』することで、発電機の損傷などを防ぎます。
- このとき、同じ規模の発電機が『解列』しても、事前の『電力需要』の大きさによって、周波数変動の大きさが異なり、『**電力需要が小さいほど周波数の変動が大きくなります**』。



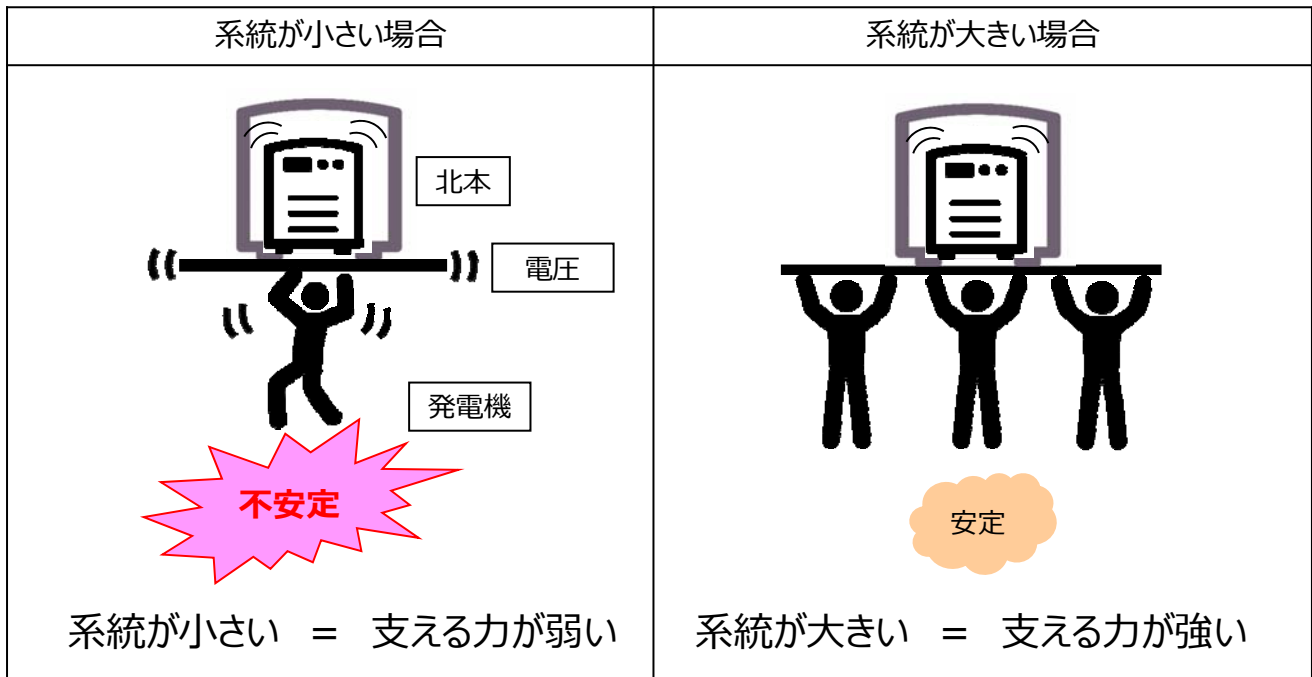
⑭ 直流-交流変換 他励式と自励式

直流-交流変換として、他励式と自励式がある。

- 他励式とは、交流系統の電源を利用して、変換器を動作させ、直流-交流変換を行う方式。
 - 自励式とは、自身の回路内に蓄えたエネルギーにより、変換器を動作させ、直流-交流変換を行う方式。他励式とは異なり交流系統の電源が無くても、直流と交流の電力変換を行える。
- ※国内での導入事例は、北斗今別直流幹線が初となります。

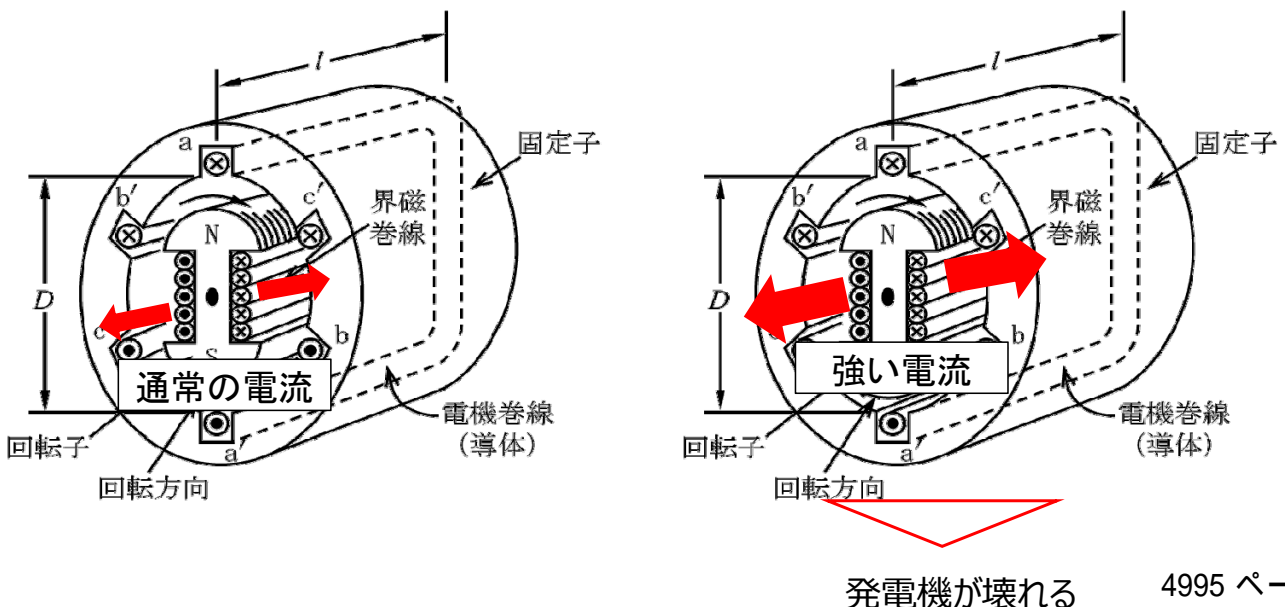


- 北本連系設備は「他励式」であり、直流の電気を交流に変換するために北海道の系統の電圧を必要とするが、系統が小さい場合は電圧が不安定となり、北本連系設備の運転ができない。
- よって、北本連系設備の運転のためには、系統を大きくする必要がある。

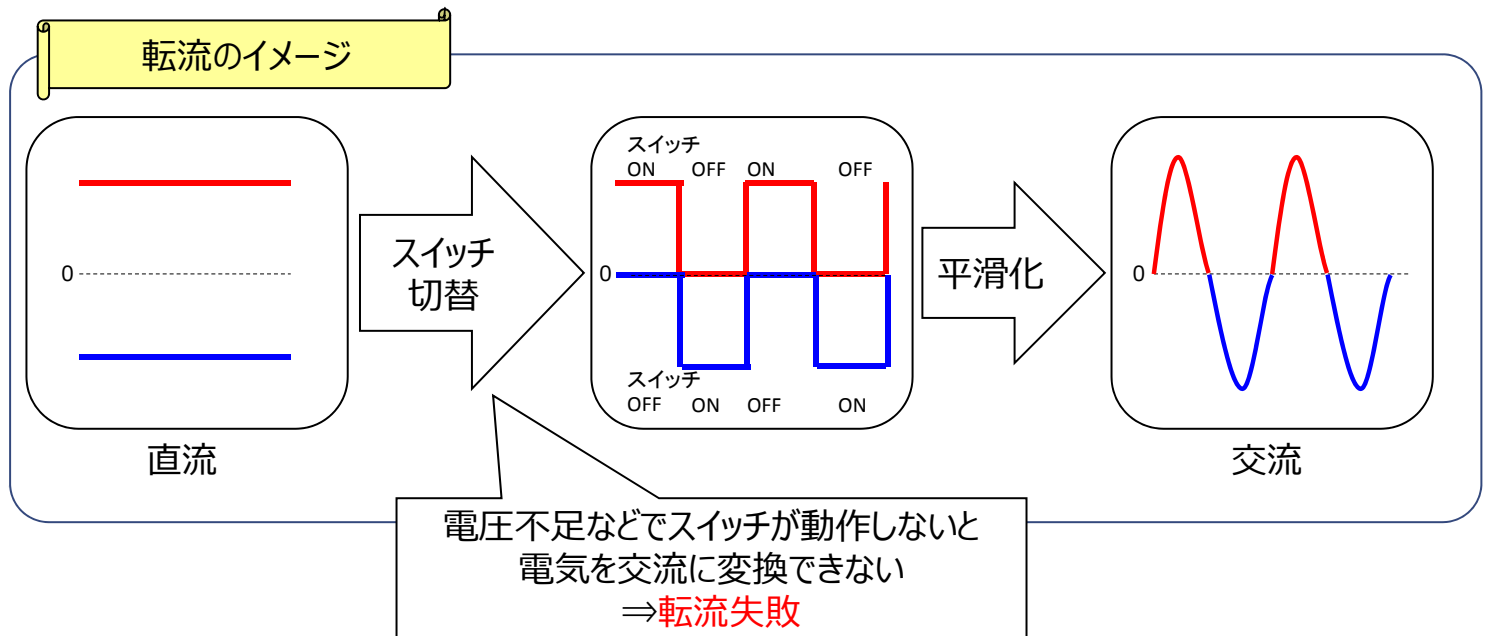


⑮ 過励磁

- 発電機にて電気を発生（発電）させるためには、発電機内部に磁石が必要であり、この磁石の強弱は、コイル（下図の界磁巻線）より行います。
- 過励磁とは、このコイル（界磁巻線）に電流が過剰に流れることを言い、発電機の一部が過熱し、壊れる可能性があります。
- また周波数が低下し、発電機の回転数が落ちてくると、上記と同様の現象が起きます。発電機が壊れないように、過励磁を検出してトリップさせて発電機を守ります。

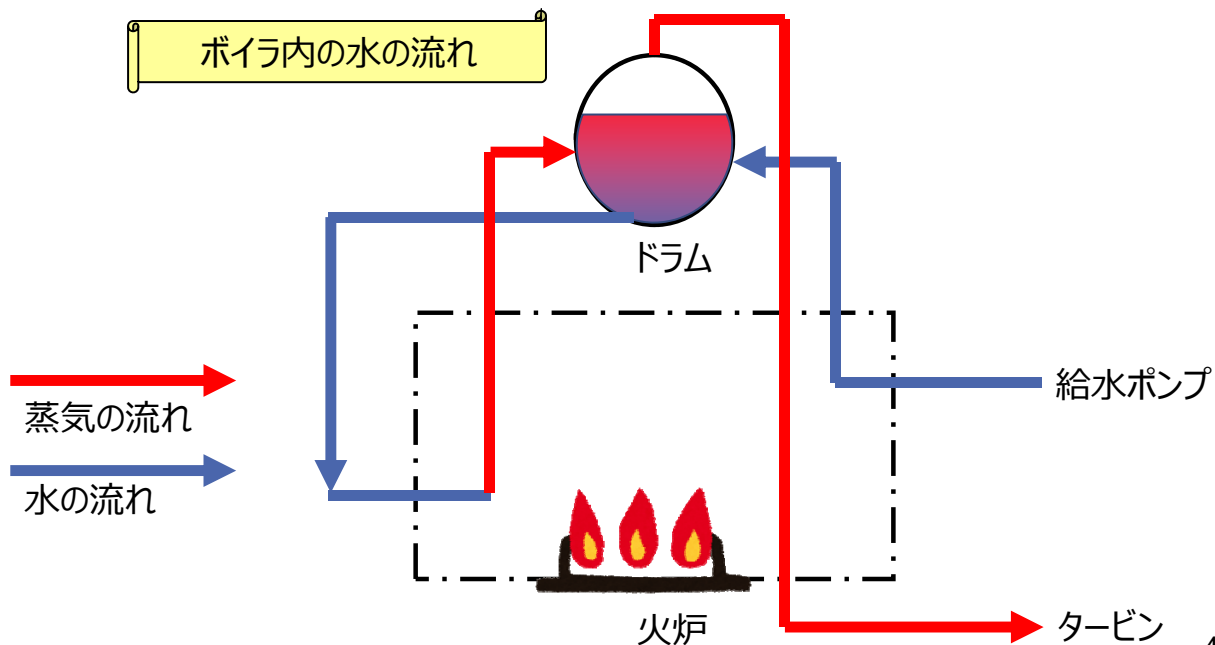


- 直流から交流に電気を変換する場合、変換設備内部のスイッチをオンおよびオフする必要があります。
- このスイッチオフ時に、直流から交流に変換されますが、このオフ制御のことを『**転流**』と言います。
- 『**転流失敗**』とは、何らかの原因によりスイッチオフ制御がうまく働かないことを言い、この場合、直流から交流に電力が変換されないこととなります。



⑪ドラム

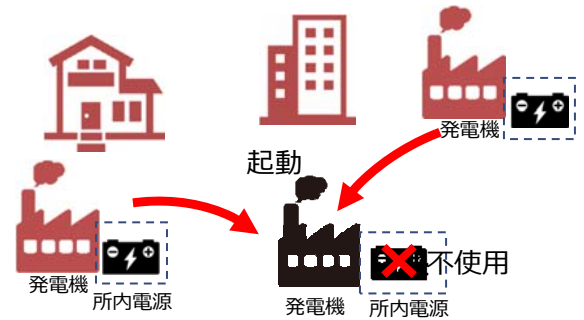
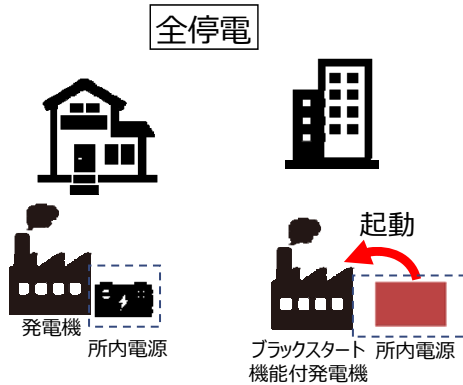
- ドラムとは火炉（かろ：燃料を燃焼させるところ）で水を加熱して生じた蒸気と水を分離し、水を再び火炉に送り出すための装置
- ドラム内の水位が低下するといわゆる空焚きのような状態になり、ボイラが損傷し使えなくなる恐れがある



■ ブラックスタートとは、ブラックアウトの状態から、外部電源より発電された電気を受電することなく、停電解消のための発電を行うことを言う。

ブラックスタート

通常の電源起動



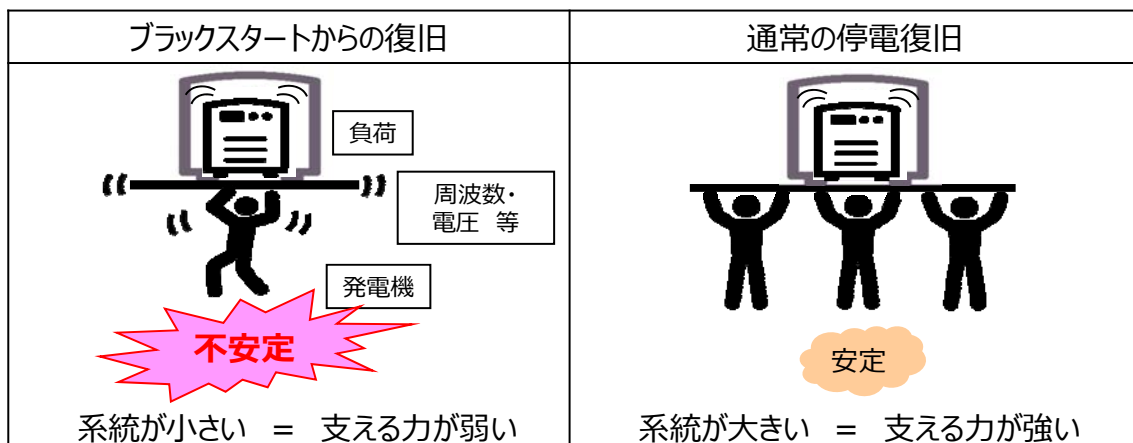
・ブラックスタート機能付発電機は、外部電源より発電された電気を受電することなく、所内電源によって起動する。

・外部電源から電気を受電し、所内電源を使わずに発電機を起動する。

⑲ ブラックスタートからの復旧について …… 通常の停電復旧との違い

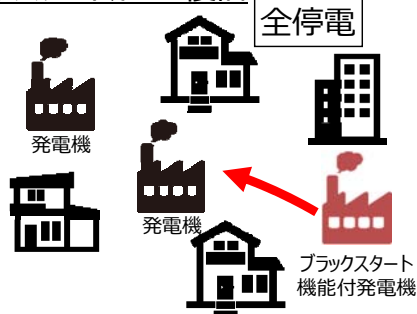
■ ブラックスタートからの復旧について

- 系統全体に電力を供給するためには、大型の火力発電機が必要となる。その火力発電機を起動するためには、その発電所の所内機器（給水ポンプやファンなど）を運転する必要があり、これらを運転するためには、ある程度大きな電力の供給が必要。
- ただし、それら所内機器の負荷は大きいので、これら機器を運転した際に、電力系統が安定でないと、周波数や電圧が大きく変動し、ブラックアウトに戻ってしまう可能性がある。
- 通常（電力系統にある程度の電力がある場合）は、その大きな電力は電力系統から安定的に供給されることになる。しかしながら、ブラックアウトの状態では、電力系統に電力がないことから、一から安定な電力を作る必要がある。



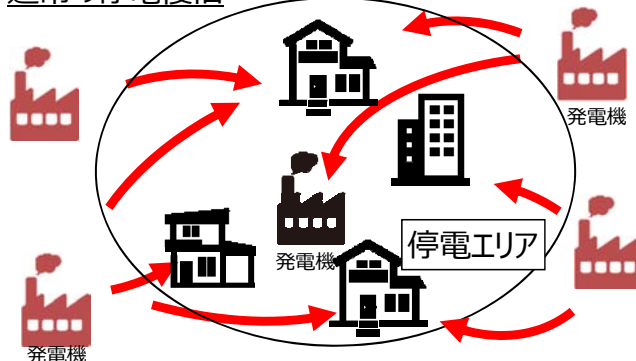
- そこで、ブラックスタートからの復旧には、まず、火力発電所の所内機器に電力を供給できる程度の発電機を、さらに小さい電源で起動することとなる。これら発電機を複数台用意してから初めて、火力発電所の所内機器への電力供給が可能となる。
- なお、火力発電所に電力を供給するために、まず送電線に電力を送電するが、電気が流れていない状態から送電線に電力を送電した際には、電圧が高くなり、機器を損壊させるおそれがある。このため、電圧を常に監視・調整しながら、復旧を進めることとなる。ただし、ブラックスタートからの復旧は、通常とは異なり、電圧を調整する機器が少なく、電圧変動も大きくなりやすいことから、注意が必要。
- 火力発電所が起動し系統に並列した後は一般負荷への電力供給となるが、一度に多くの電力を供給すると、需要と供給のバランスが崩れて周波数が変動し、ブラックアウトに戻ってしまう可能性がある。よって、一般負荷への電力供給も、中央での監視・指示のもとで少しずつ行うこととなる。この際、電圧の監視・調整も必要。

ブラックスタートからの復旧



- ・ブラックスタート機能が付いた一部の発電機から、少しずつ周囲の発電機を起動させる。
- ・系統が極めて小さく、少しの動揺で系統が大きく変動し不安定。

通常の停電復旧



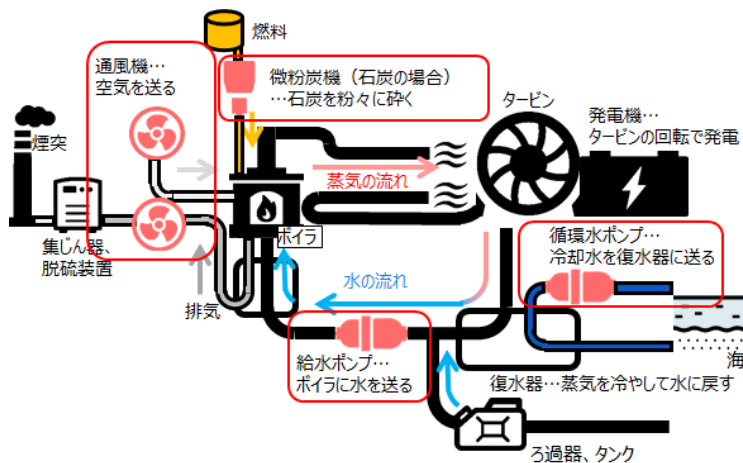
- ・外部からの電気で発電機が起動できる。
- ・外部から系統を支えてもらい安定的に復旧。

⑳ 所内電源 (火力)

■ 補機 (発電機起動のための所内機器) に必要な電力 :

発電機の起動には、所内機器 (通風機、ポンプ、微粉炭機等) へ電力供給が必要であり、特に、その始動時には定格時より大きな電源が必要となる。

補機の始動電流負荷/定格負荷[kVA] (一例)



| 発電所 補機名 | 砂川 | | 奈井江 | 知内 | 伊達 | |
|------------|----------------|---------------|----------------|----------------|----------------|----------------|
| | 3号 | 4号 | 1,2号 | 1号 | 1号 | 2号 |
| 押込通風機 | - | 3800 /470 | 3800 /560 | 22300 /3050 | 16500 /2400 | 17400 /2580 |
| 誘引通風機 | 4900 /700 | 3800 /610 | 4900 /850 | - | - | - |
| ガス再循環通風機 | - | - | - | 22900 /2700 | 8700 /1250 | - |
| ガス混合通風機 | - | - | - | - | 3100 /410 | 4400 /650 |
| 電動ボイラ給水ポンプ | 10900 /1450 | 6100 /2500 | 11100 /1750 | 29600 /3650 | 17300 /2580 | 17200 /2550 |
| 循環水ポンプ | - | 3300 /470 | 3200 /540 | 17800 /1900 | 11100 /1530 | 1110 /1550 |
| 取水ポンプ | 8200 /850 | - | 3000 /360 | - | - | - |
| 微粉炭機 | 4000 /450 | 4600 /450 | 3300 /470 | - | - | - |

■ 保安用所内電源 :

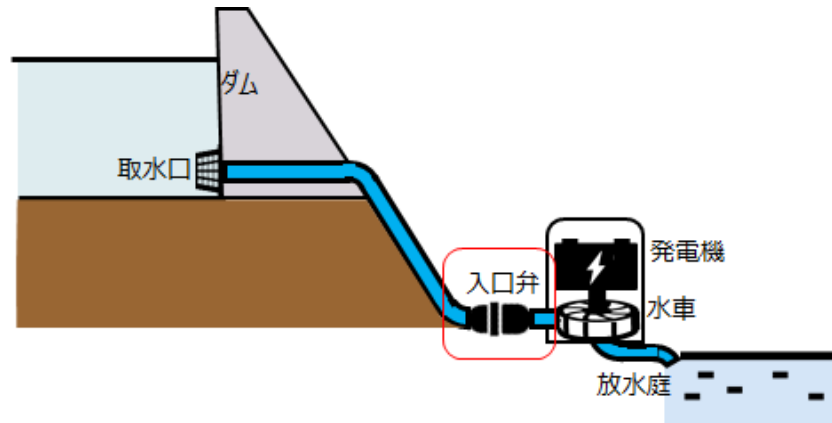
保安用電力は、人命および施設を保護するために必要な最小限度の電力。保安用の所内電源の出力は、補機の運転に使用するには小さい。

| 発電所 | 砂川 | 奈井江 | 知内 | 伊達 |
|------------|----------|----------|----------|-------------------|
| 非常用電源出力×台数 | 240kW×2台 | 280kW×1台 | 600kW×1台 | 520kW×1台 640kW×1台 |

- 水力発電機は、入口弁等のバルブを操作することで起動できるので、ブラックスタート時の起動用電源に必要な容量は火力発電機と比べて小さい。

ブラックスタート時の起動用電源容量

| 発電所 | 高見 | 新冠 |
|------|--------|----------|
| 電源容量 | 625kVA | 1,500kVA |



㉑負荷と電圧の関係

- 電気機器には、電圧が高くなると消費電力が増加するものが存在する。
- 以下の例のように照明などは電圧の2乗に比例して消費電力が増大する。

「電圧が高くなると明るくなる = 消費電力が大きくなる」



電池の電圧をV、電球の抵抗をR、電流をIとすると
 $I = V \div R$
 となる。(オームの法則)
 このとき電球の消費電力をPとすると
 $P = V^2 \div R$
 となる。

電池を増やし、電圧上昇させると、電球の明るさが増し消費電力が増加する。
 下図のように電圧が倍になると消費電力は、
 $P' = (2V)^2 \div R$
 $= 4 \times P$
 となり電圧上昇前の4倍になる。