



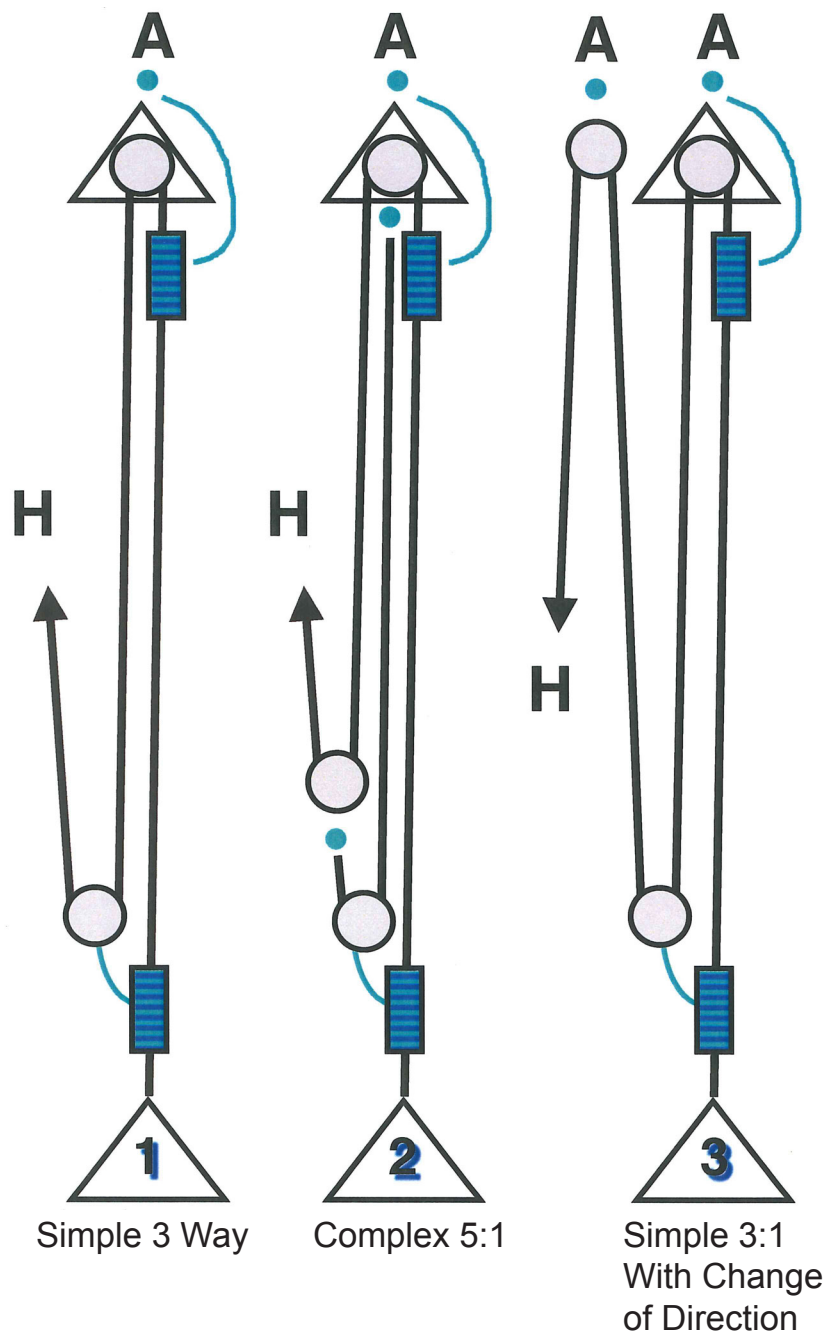
APPENDIX 2. ILLUSTRATIONS

2.1 RIGGING ILLUSTRATIONS

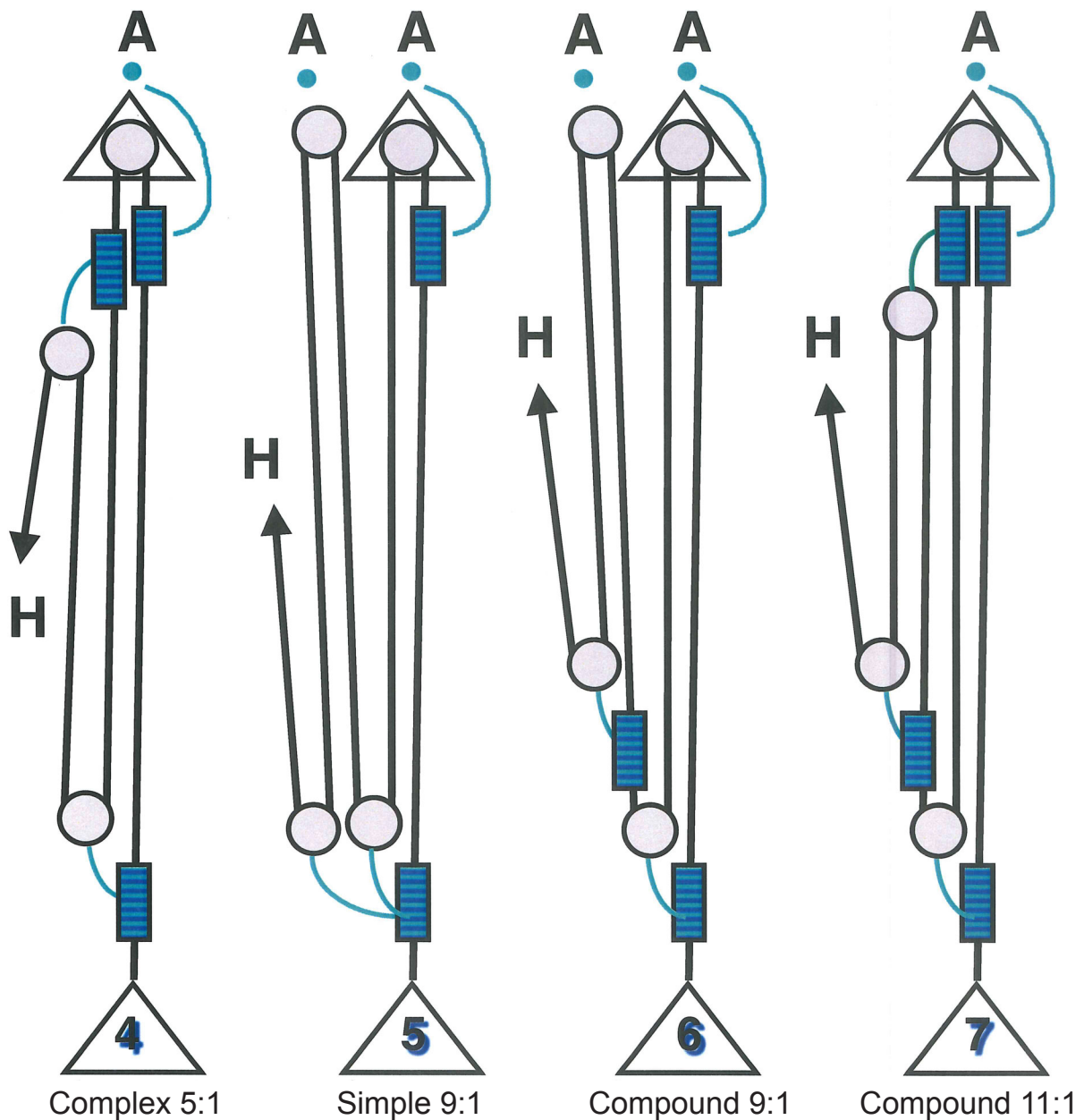
2.1.A MECHANICAL ADVANTAGE

Creating mechanical advantage is necessary to reduce the amount of strength required to lift heavy loads. There is a multitude of devices out there that can be purchased which have mechanical advantage built into them; consider a block and tackle or a capstan winch.

While these devices tend to do most of the work for you, especially if powered, they are not recommended for most common rescue attempts because it is not easy for the person using the device to notice the increased resistance if someone or something has become stuck while moving. This can lead to very serious consequences if not noticed such as breaking and arm or leg or worse.



With that said, a rescue attempt usually means that someone's life is in immediate jeopardy and careful consideration should be put into (1) what equipment is on hand, (2) who is properly trained on it, and (3) how dire the emergency is. Still, many at height workers do not have these mechanical devices on hand, and knowing how to create mechanical advantage with ropes and pulleys is one of the most important skills a worker can have when a rescue is necessary. Building mechanical advantage with ropes and pulleys can be very simple once trained and it should be a skill that all tower workers possess.

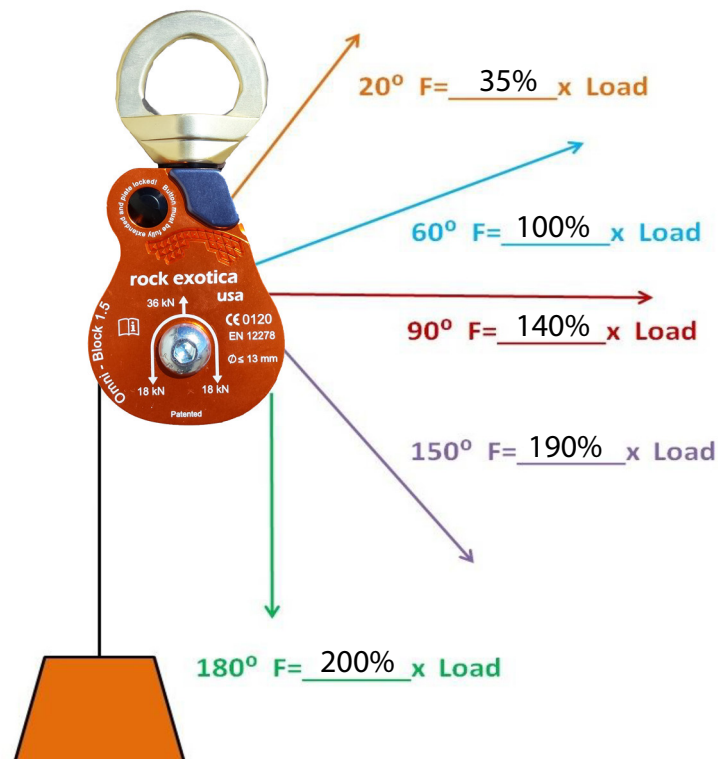


2.1.B VECTOR FORCES

What is a Vector Force?

Answer: A quantity possessing magnitude and direction.

Now that you understand how to build mechanical advantage systems and how to use them to your advantage, you must also understand the limitations and dangers that apply to using them. We will now look at the forces generated when moving loads in multiple directions. Since we can easily create a large amount of mechanical advantage, we now need to understand the Resultant Forces that we generate on the equipment. If you haven't heard of the Critical Angle before you should add it to your vocabulary now as it will become essential to recognizing dangerous situations while using standard rigging and hoisting techniques.



Pully Forces.

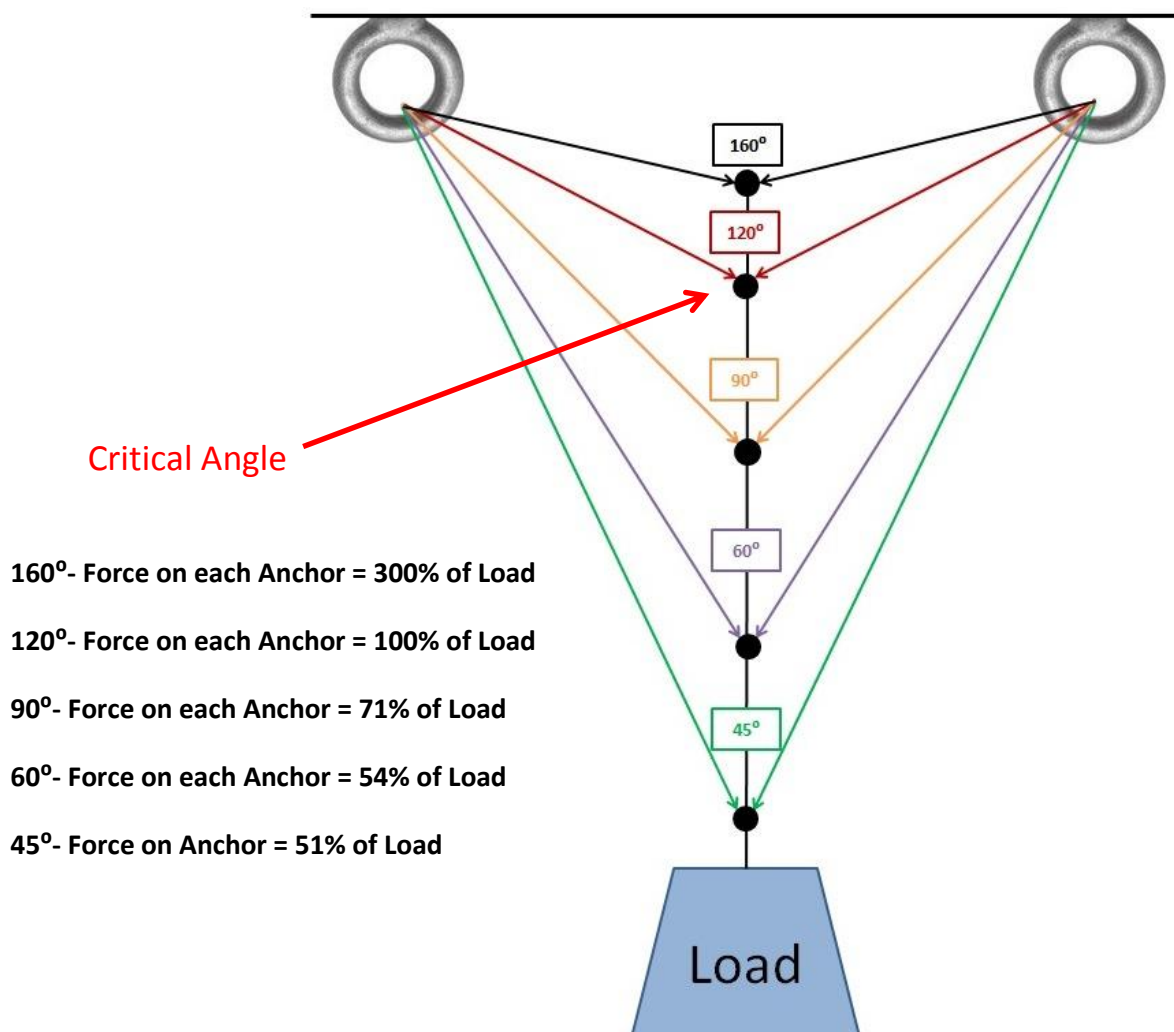


Resultant Force- The combination of multiple vector forces acting on a body.

Critical Angle- The Included Angle where above which the load is putting more force on the anchor(s) than the weight of the load.

Forces on Anchors

Any time a load is hanging directly under an anchor point, that anchor point is seeing 100% of the force in the vertical (single) direction. If you swing the load so that it is not directly under the anchor point, you have now introduced a direction of pull in the horizontal axis as well. That anchor point will now be seeing even more than 100% of the force of the load. Not understanding vector forces and the angles that you are using them can be a fatal mistake when lifting loads overhead or performing a rescue.





2.2 PROCEDURE ILLUSTRATIONS

2.2.A HVA CROSS TIE PRE-FORM MAINTENANCE

PLANNING & PREP

1



HVA cross tie pre-form maintenance:

MAKING UP DEFLECTION SIDE RIGGING - 1

2

KEY:

Ground Crew



Tower Climber



Guy Spacer Worker



MAIN LIFTING / LOWERING SIDE

DEFLECTION SIDE

**KEEP ROPES ORGANIZED
WITH NO TWISTING!**

Temporarily
anchor top end
of rope on leg

250' deflection line

Allow rope to
run out of bag

Single Omni
Block® pulled
to opposite leg

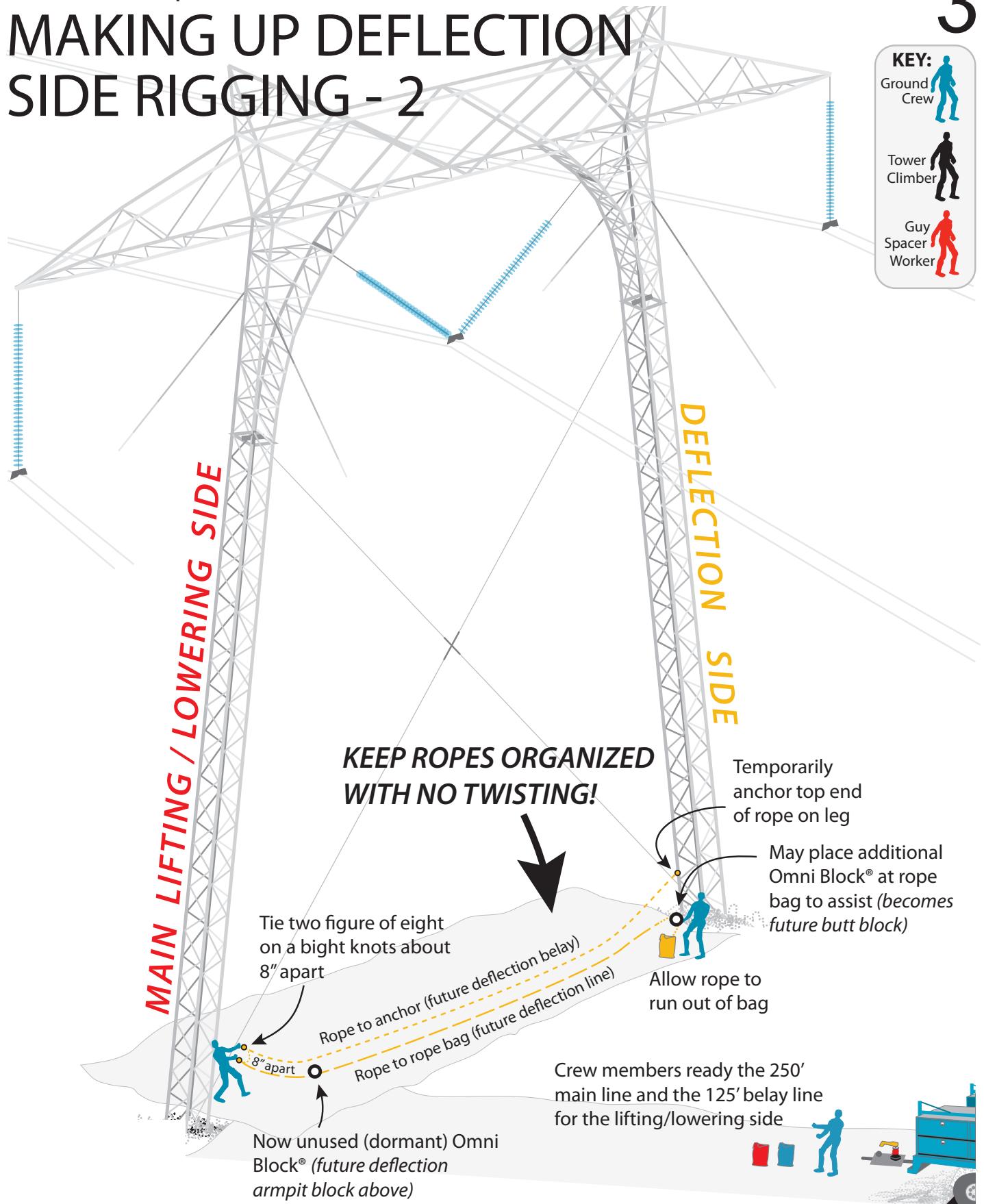
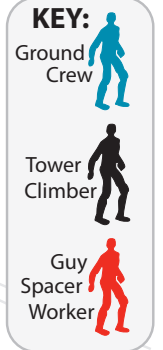
Crew members ready the 250'
main line and the 125' belay line
for the lifting/lowering side



HVA cross tie pre-form maintenance:

MAKING UP DEFLECTION SIDE RIGGING - 2

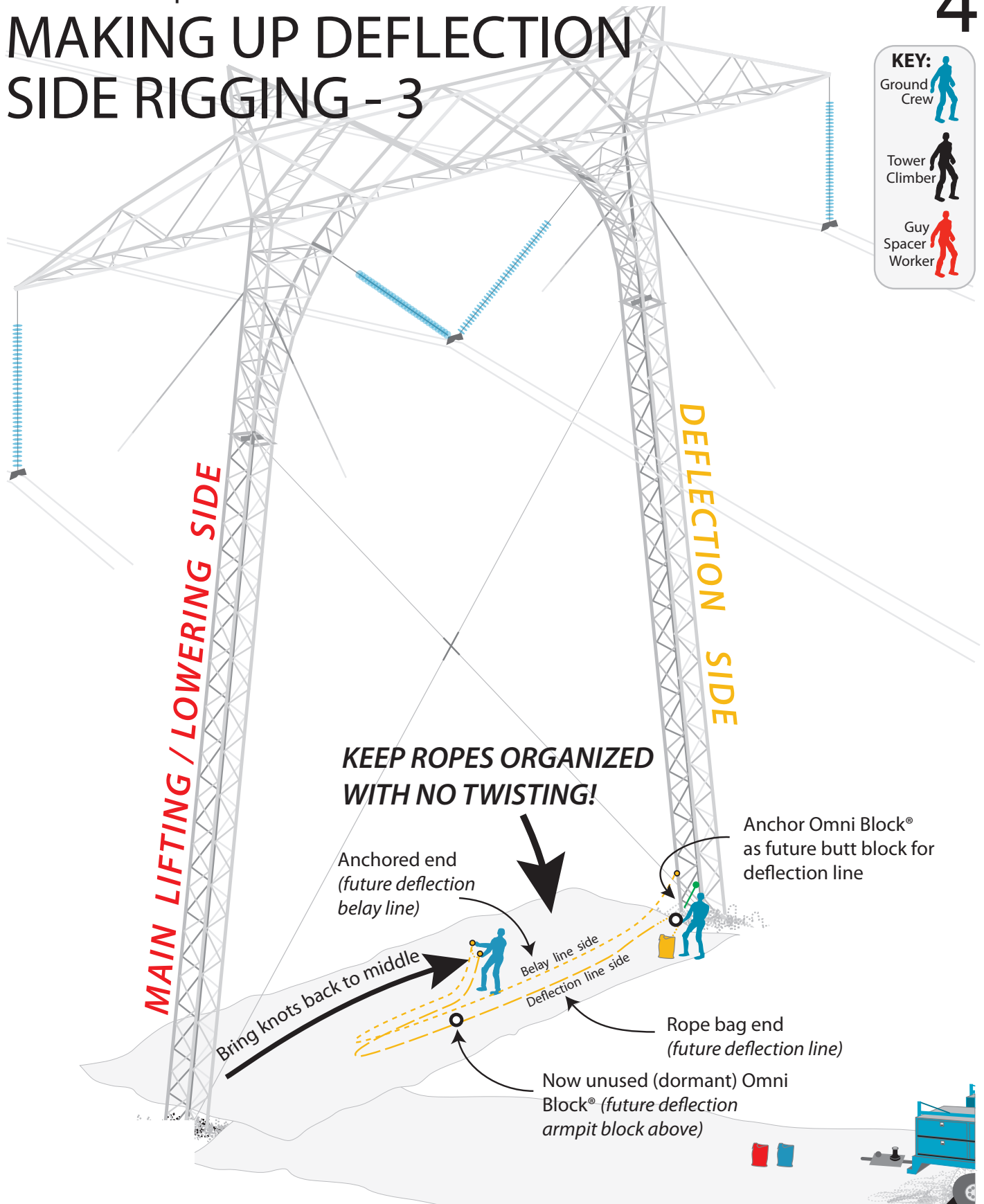
3



HVA cross tie pre-form maintenance:

MAKING UP DEFLECTION SIDE RIGGING - 3

4





HVA cross tie pre-form maintenance:

MAKING UP DEFLECTION SIDE RIGGING - 4

5



MAIN LIFTING / LOWERING SIDE

DEFLECTION SIDE

**KEEP ROPES ORGANIZED
WITH NO TWISTING!**

Anchored end
(future deflection
belay line)

Bring ends to roughly
middle of tower under
cross tie above

Stopper knot
ASAP® LOCK



Belay
side
Deflection side

Make up end of deflection
line with double overhand
stopper knot
Place ASAP® LOCK on rope,
"UP" and arrow pointing
away from stopper knot

Single Omni Block®
(future butt block)

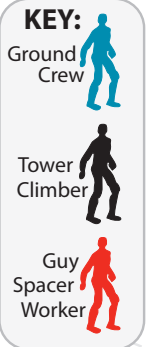
Waiting (dormant)
single Omni Block®
(future armpit block)

Rope bag end
(future deflection line)

HVA cross tie pre-form maintenance:

MAKING UP MAIN LIFTING/ LOWERING SIDE RIGGING - 1

6



MAIN LIFTING / LOWERING SIDE

DEFLECTION SIDE

Make up deflection yoke rigging:

Attach double Omni Block® with carabiner to knot going to deflection rope bag
In order, clip main line (red) and belay line (blue) into each side of double block
 Use safety carabiner on second knot (deflection belay) and clip around both the main and belay lines **above** the double block

125' belay line (blue) in rope bag

250' main lifting/
lowering line (red)
in rope bag

Double Omni Block®
(Deflection side)
Safety carabiner
(Belay side)

Tie two figure of eight on a bight knots
in the end of both ropes

Clip one carabiner to each
(future connections to suspended worker)

Deflection
rope bag

MAKING UP MAIN LIFTING/ LOWERING SIDE RIGGING - 2

7



HVA cross tie pre-form maintenance:

MAKING UP MAIN LIFTING/ LOWERING SIDE RIGGING - 3

8

KEY:

Ground Crew

Tower Climber

Guy Spacer Worker

Make up end of belay line with double overhand stopper knot
Place ASAP® LOCK on rope, "UP" and arrow pointing away from stopper knot

MAIN LIFTING / LOWERING SIDE

**KEEP ROPES ORGANIZED
WITH NO TWISTING!**

Upper end of belay rope stacked at base of tower

Belay line (for main line)
Main lifting/lowering line

250' main lifting/
lowering line rope bag

125' belay line
rope bag (now empty)

DEFLECTION SIDE

Belay side
Deflection side

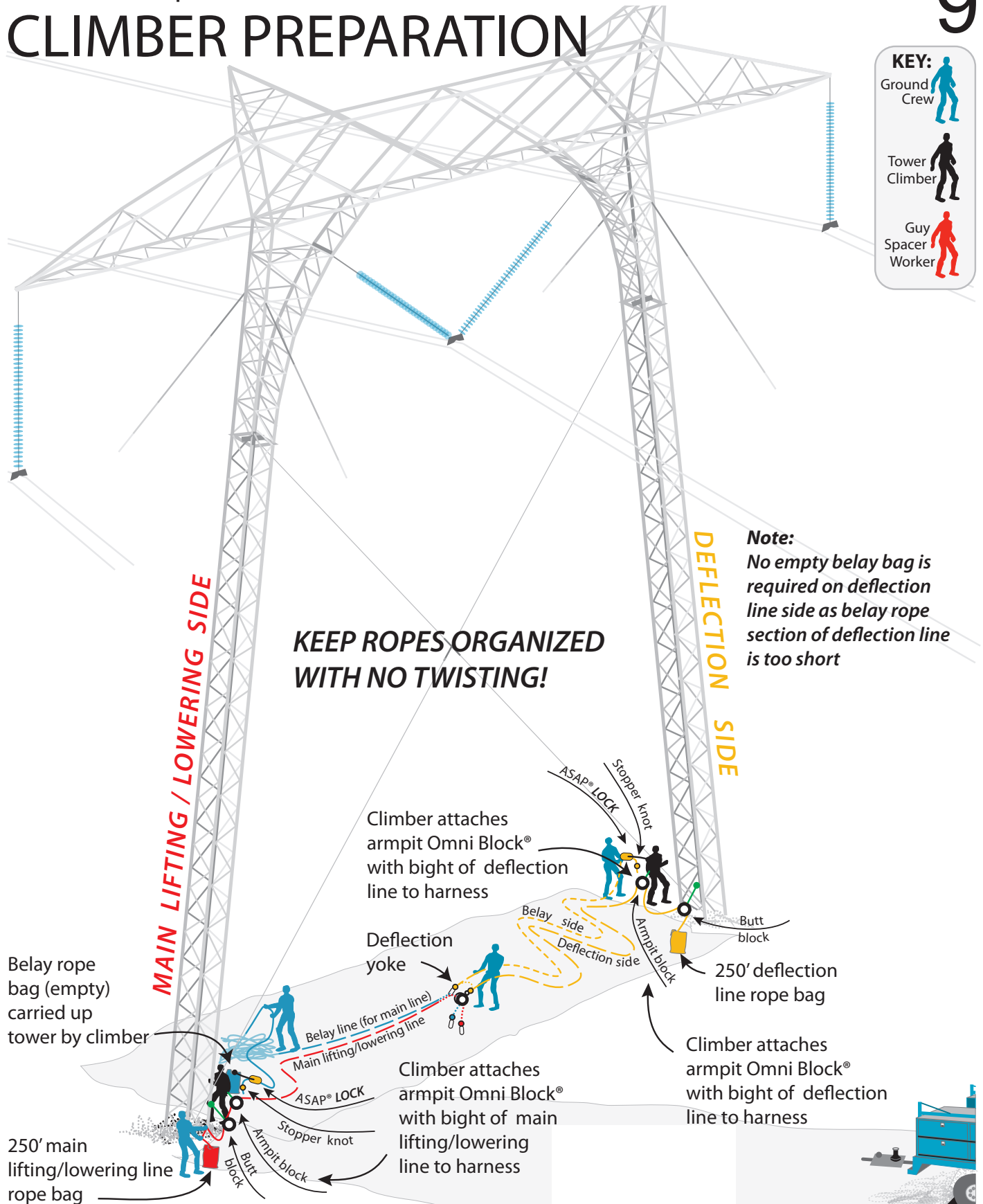
ASAP® LOCK
Stopper knot



HVA cross tie pre-form maintenance:

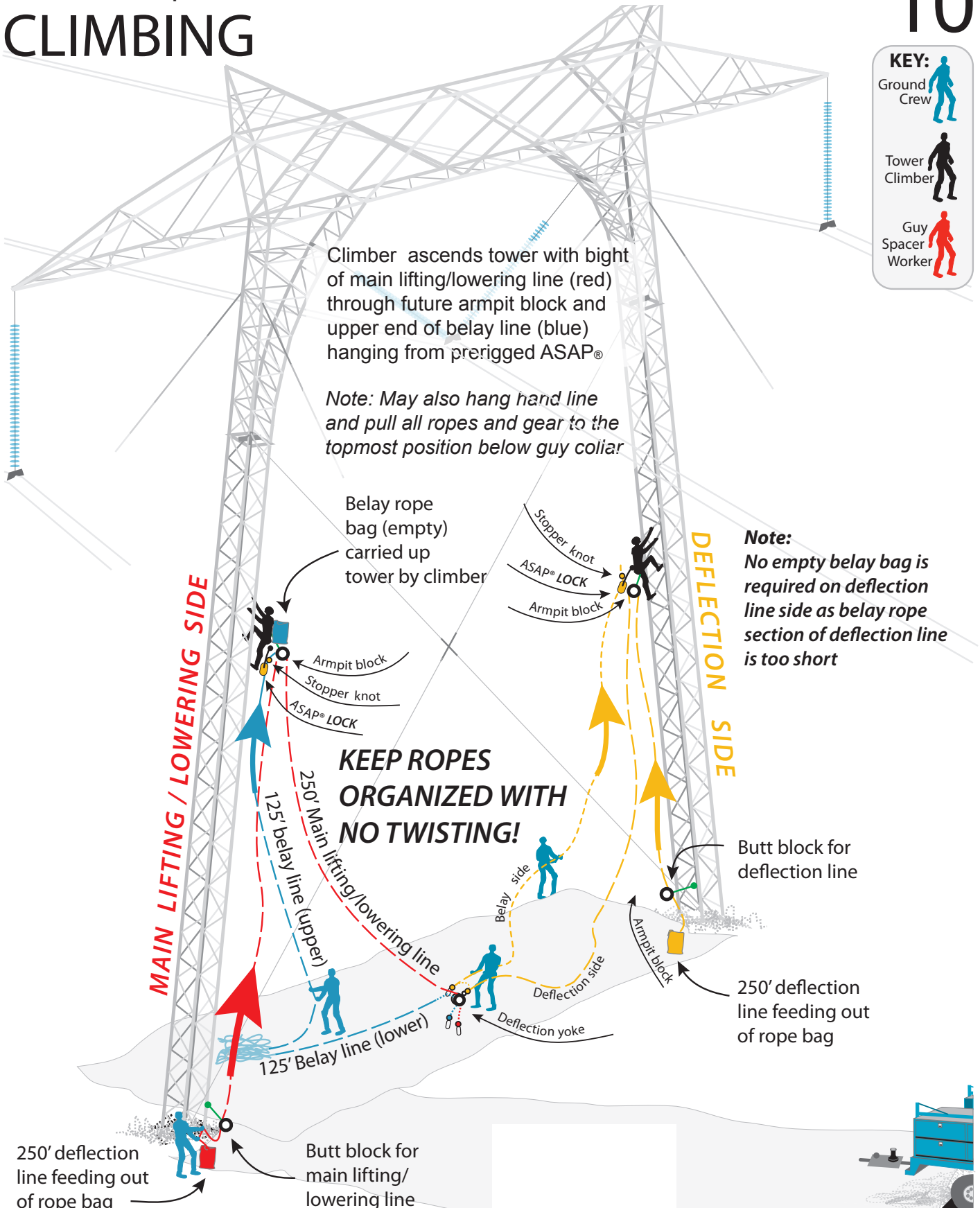
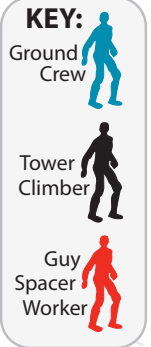
CLIMBER PREPARATION

9



HVA cross tie pre-form maintenance: CLIMBING

10

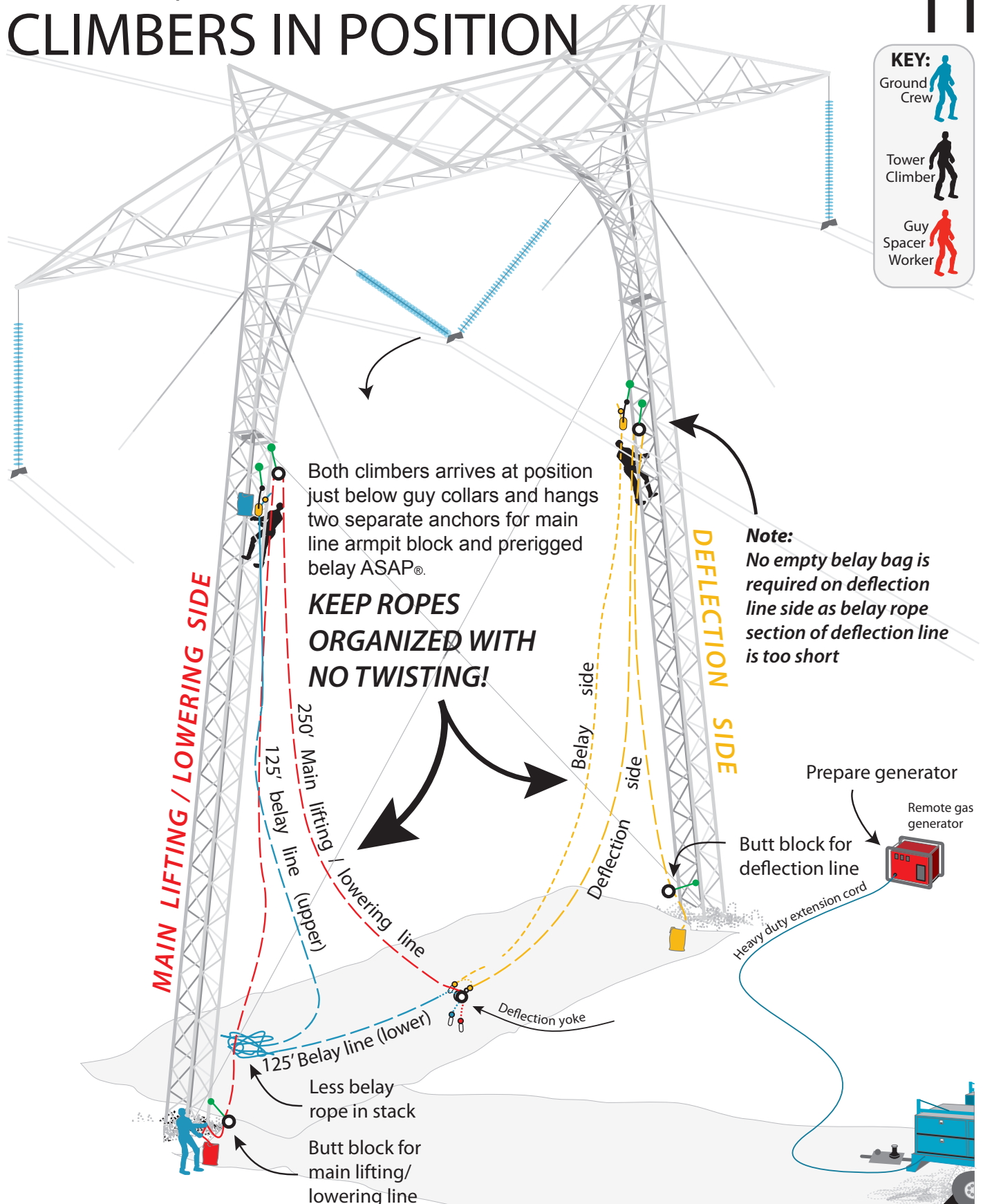
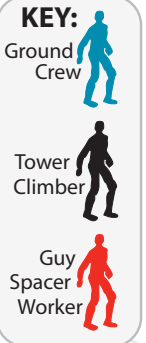




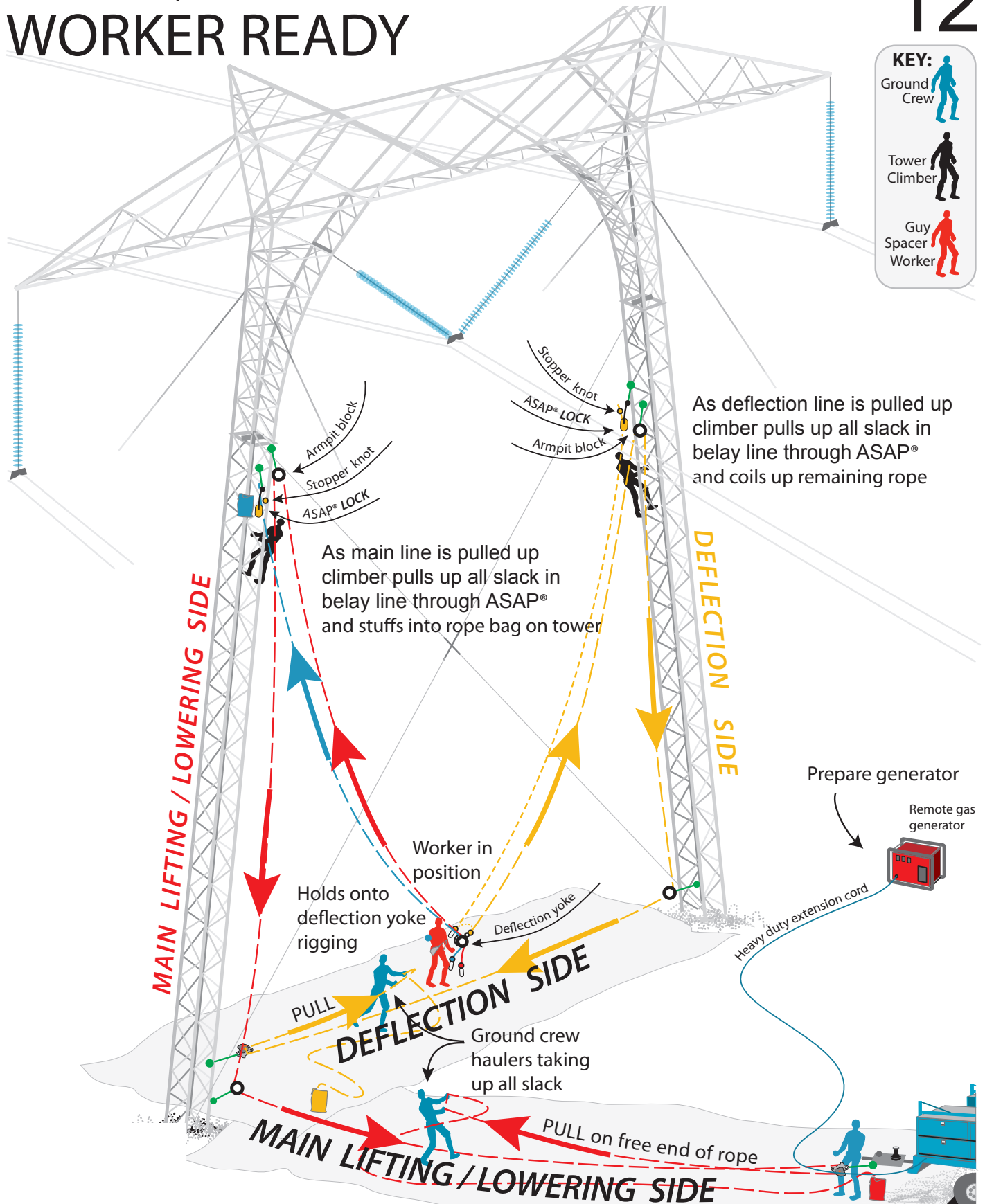
HVA cross tie pre-form maintenance:

CLIMBERS IN POSITION

11



12





HVA cross tie pre-form maintenance:

TAKE UP ALL SLACK - READY TO LIFT WORKER

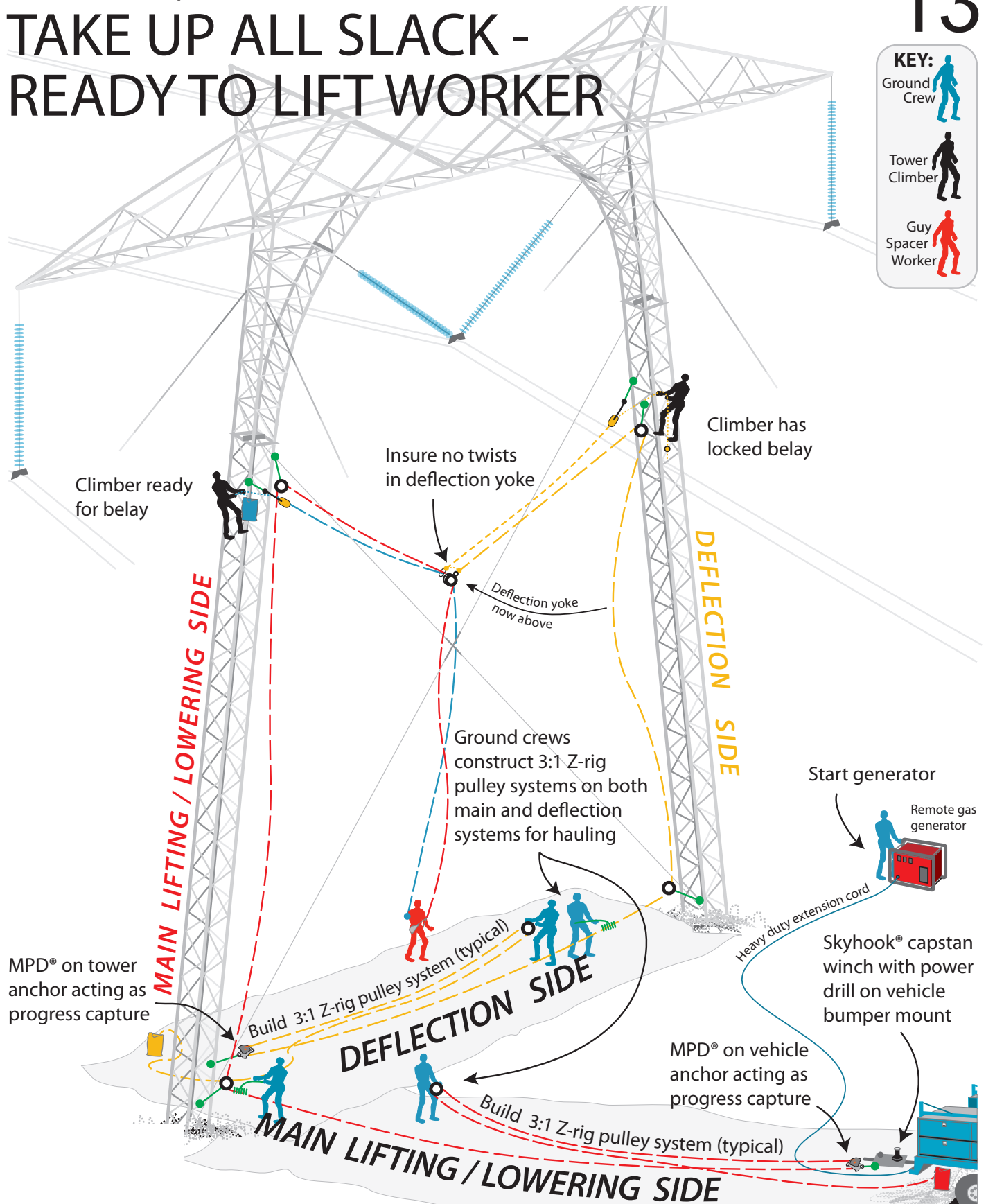
13

KEY:

Ground Crew

Tower Climber

Guy Spacer Worker



HVA cross tie pre-form maintenance:

FINAL RIGGING CHECK - SET DEFLECTION LINE

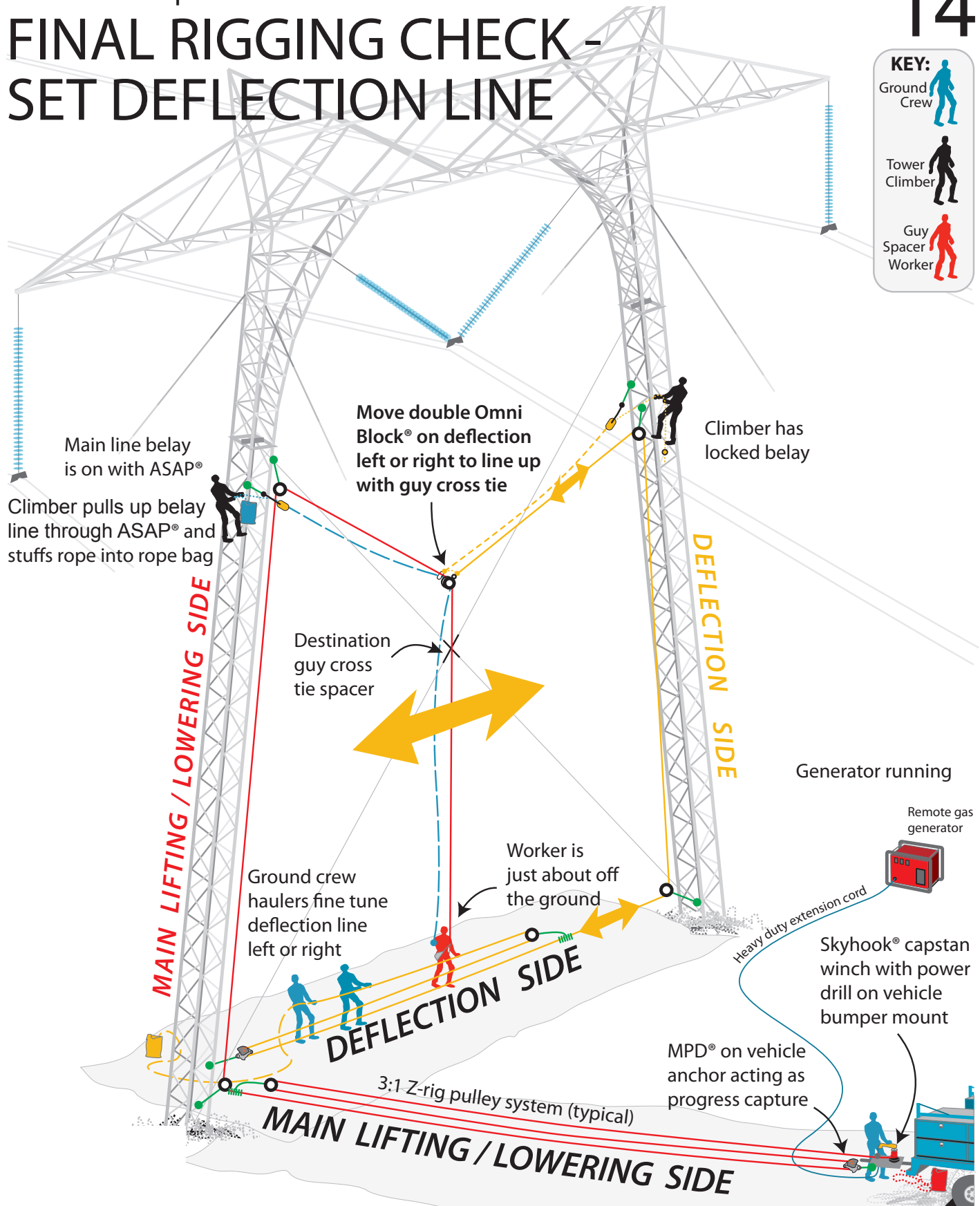
14

KEY:

Ground Crew

Tower Climber

Guy Spacer Worker

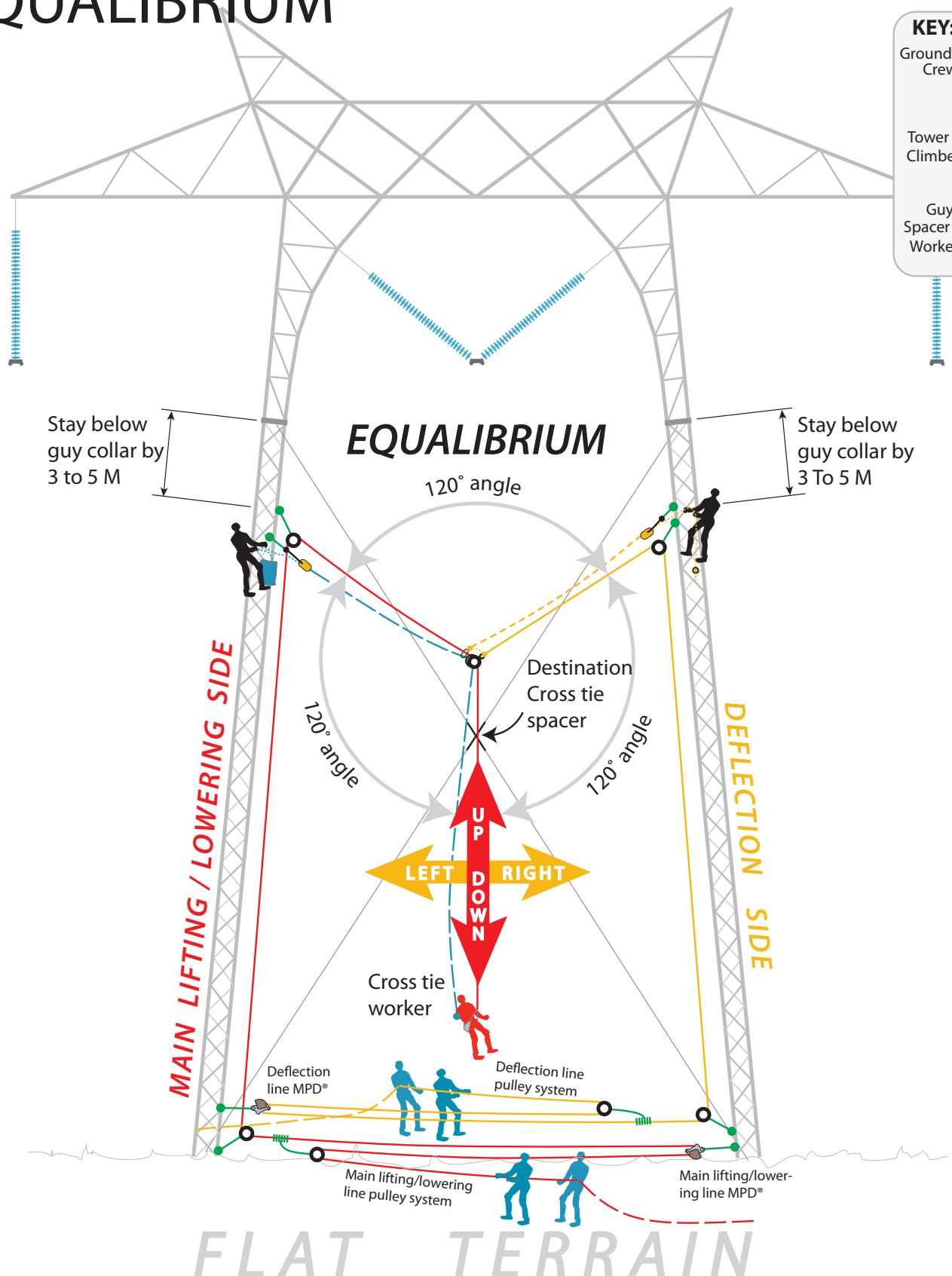
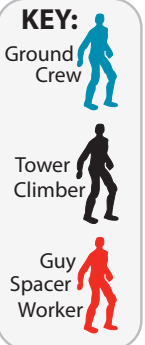




HVA cross tie pre-form maintenance:

EQUALIBRIUM

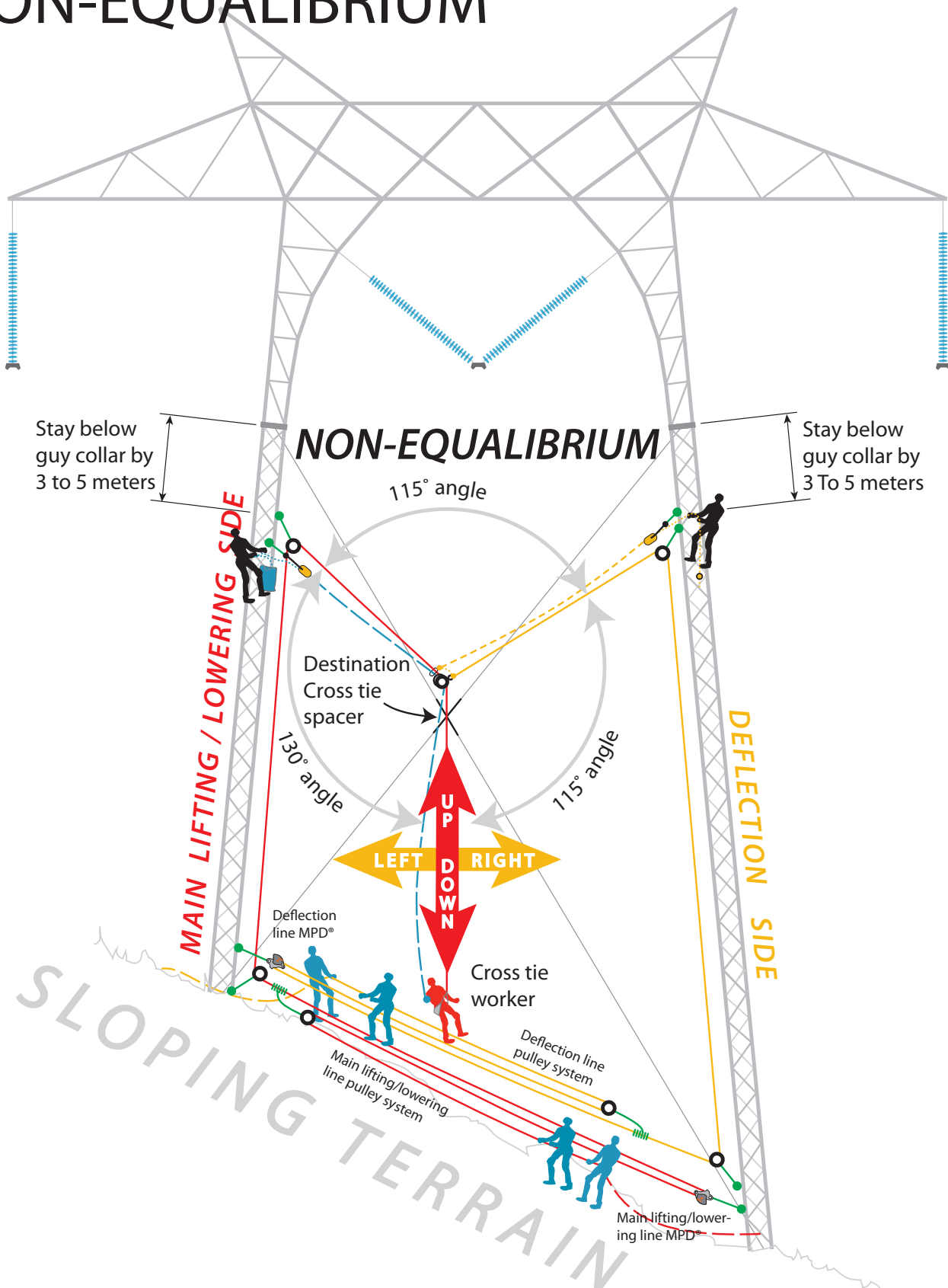
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HVA cross tie pre-form maintenance:

NON-EQUALIBRIUM

14



15



Ground Crew

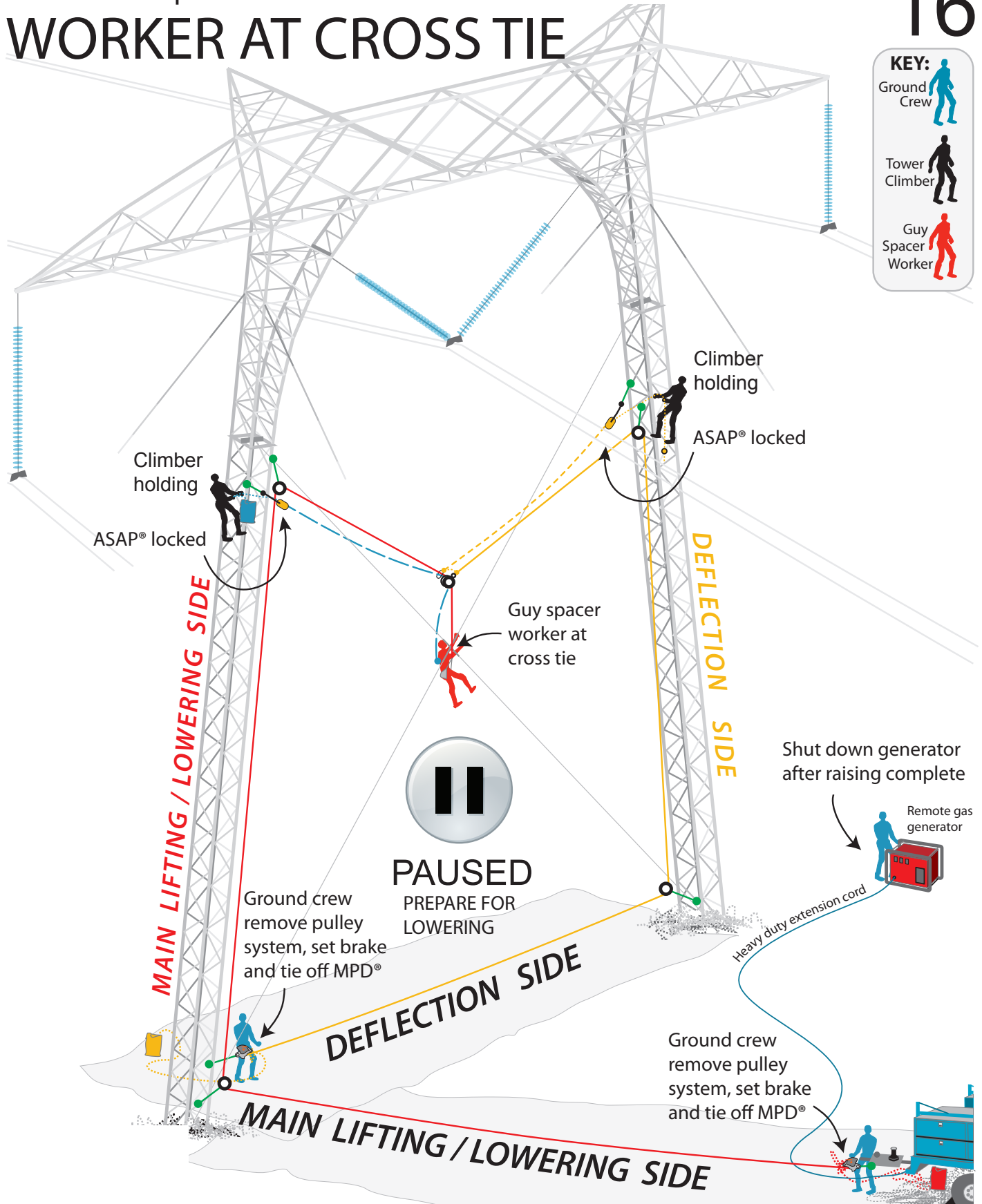
Tower Climber

Guy
Spacer
Worke

HVA cross tie pre-form maintenance:

WORKER AT CROSS TIE

16





HVA cross tie pre-form maintenance:

WORK COMPLETE - LOWER WORKER

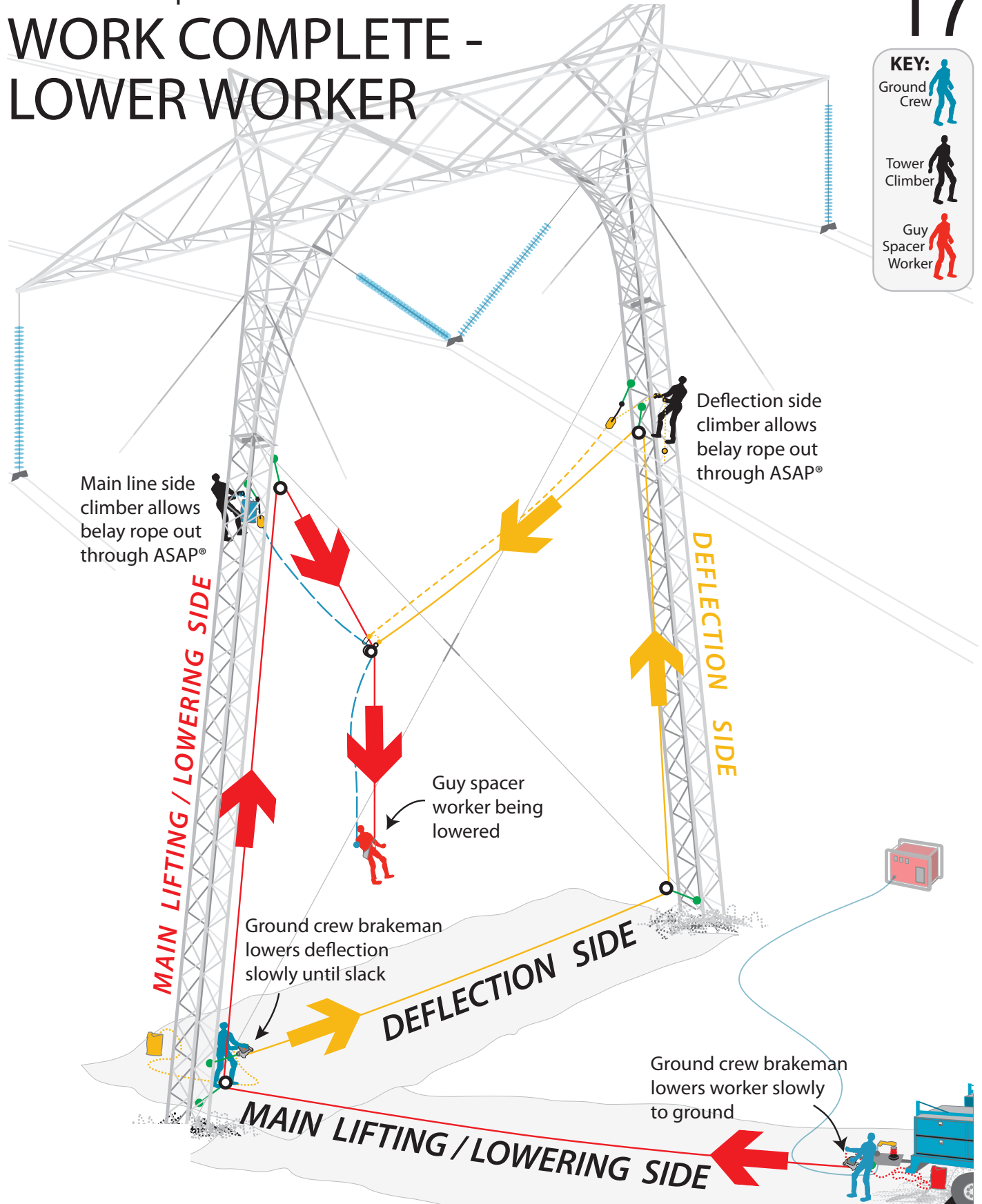
17

KEY:

Ground Crew

Tower Climber

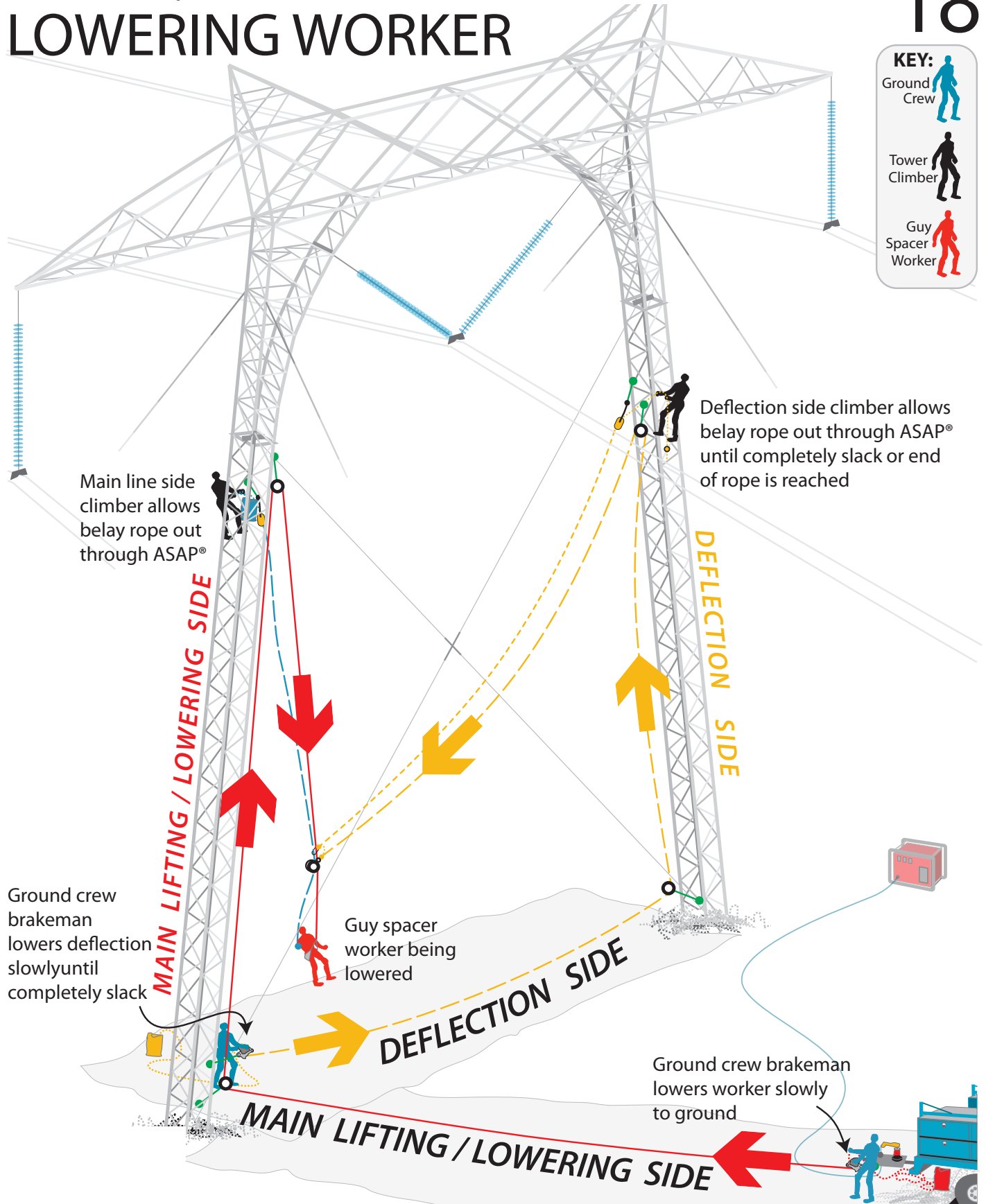
Guy Spacer Worker



HVA cross tie pre-form maintenance:

LOWERING WORKER

18





HVA cross tie pre-form maintenance:

WORKER DOWN - SAFE

19

KEY:

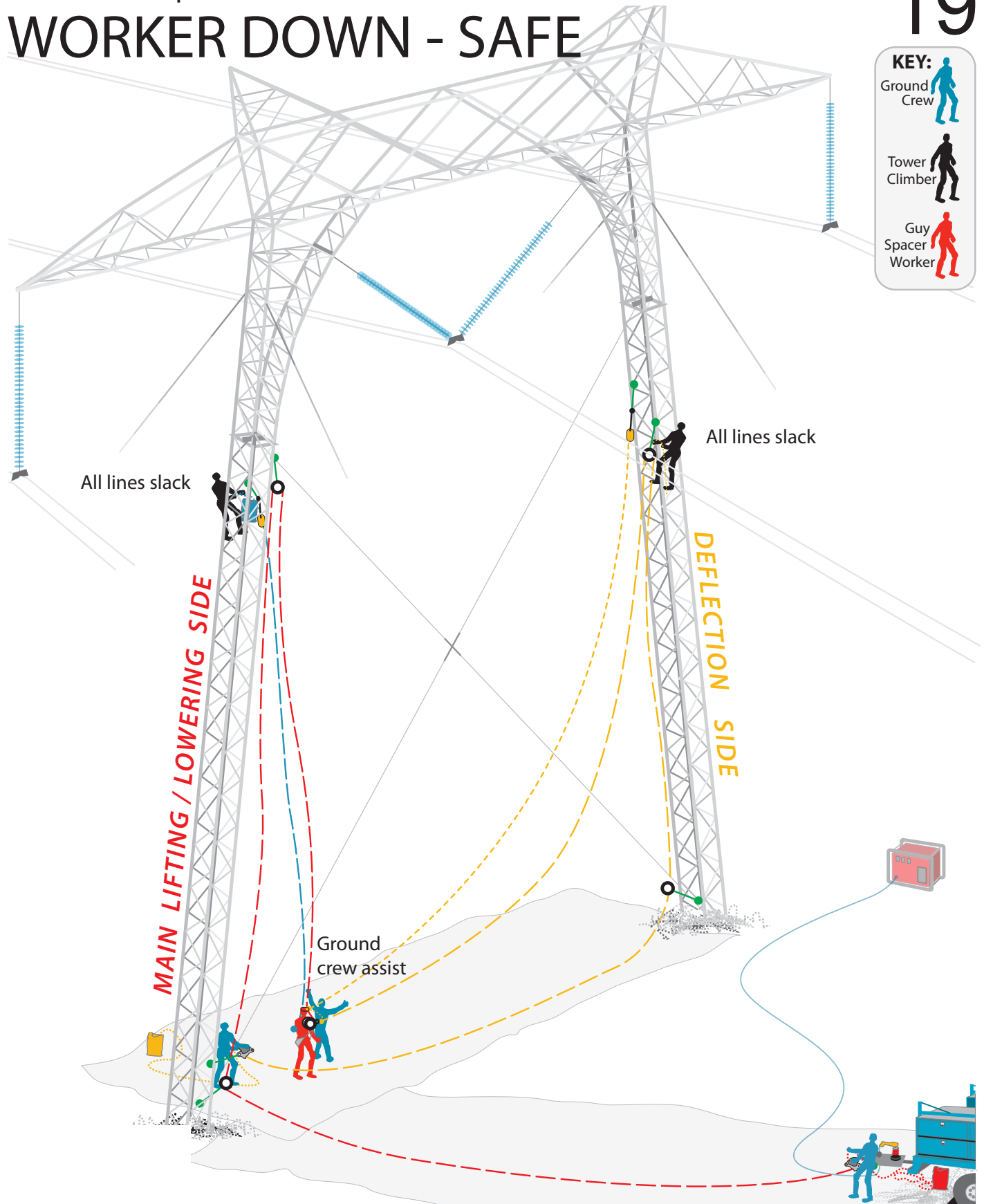
Ground Crew



Tower Climber



Guy Spacer Worker



HVA cross tie pre-form maintenance:

DROP ROPES - TEAR DOWN

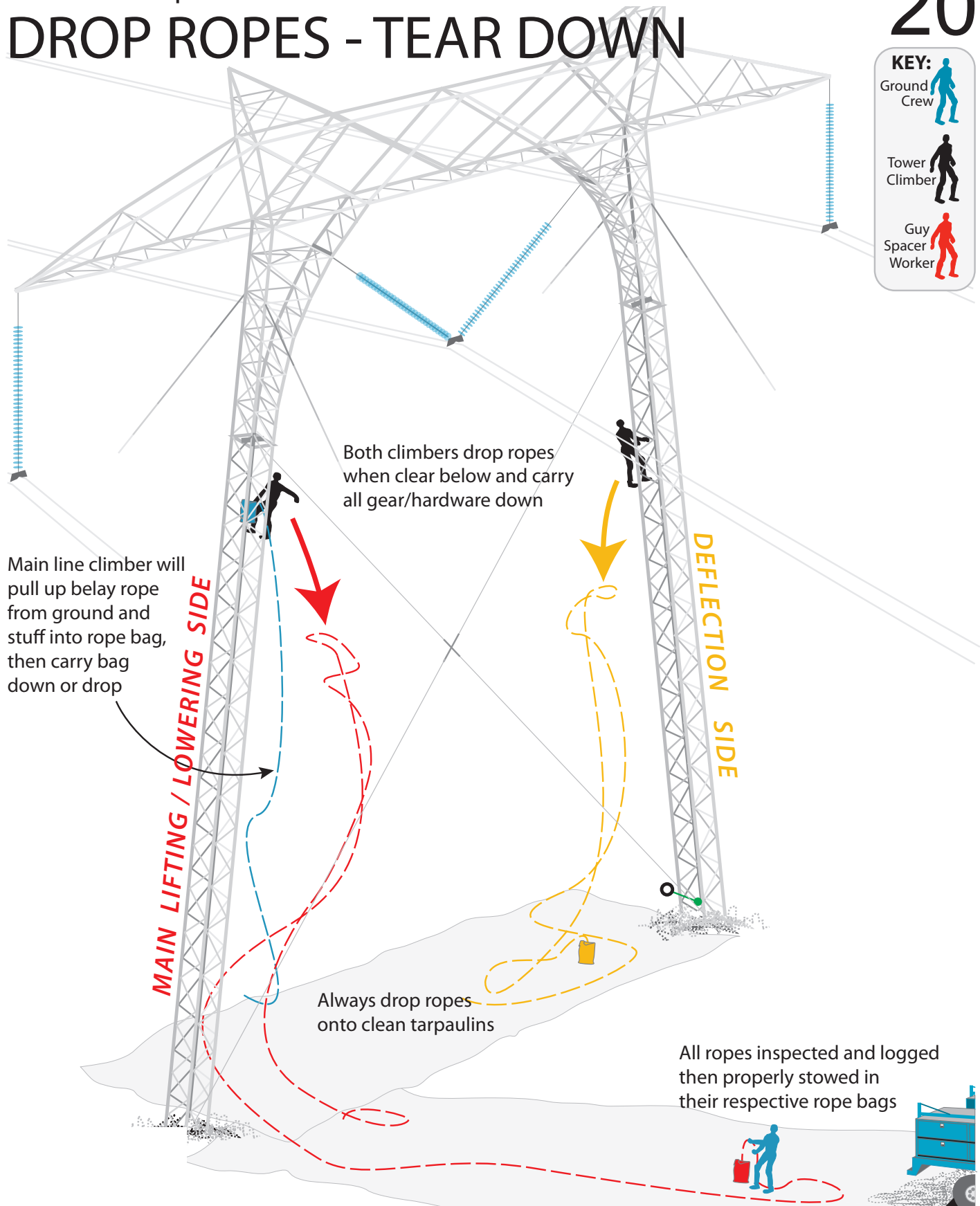
20

KEY:

Ground Crew

Tower Climber

Guy Spacer Worker





HVL cross tie pre-form maintenance:

HVL TOWER SET UP CONSIDERATIONS - 1

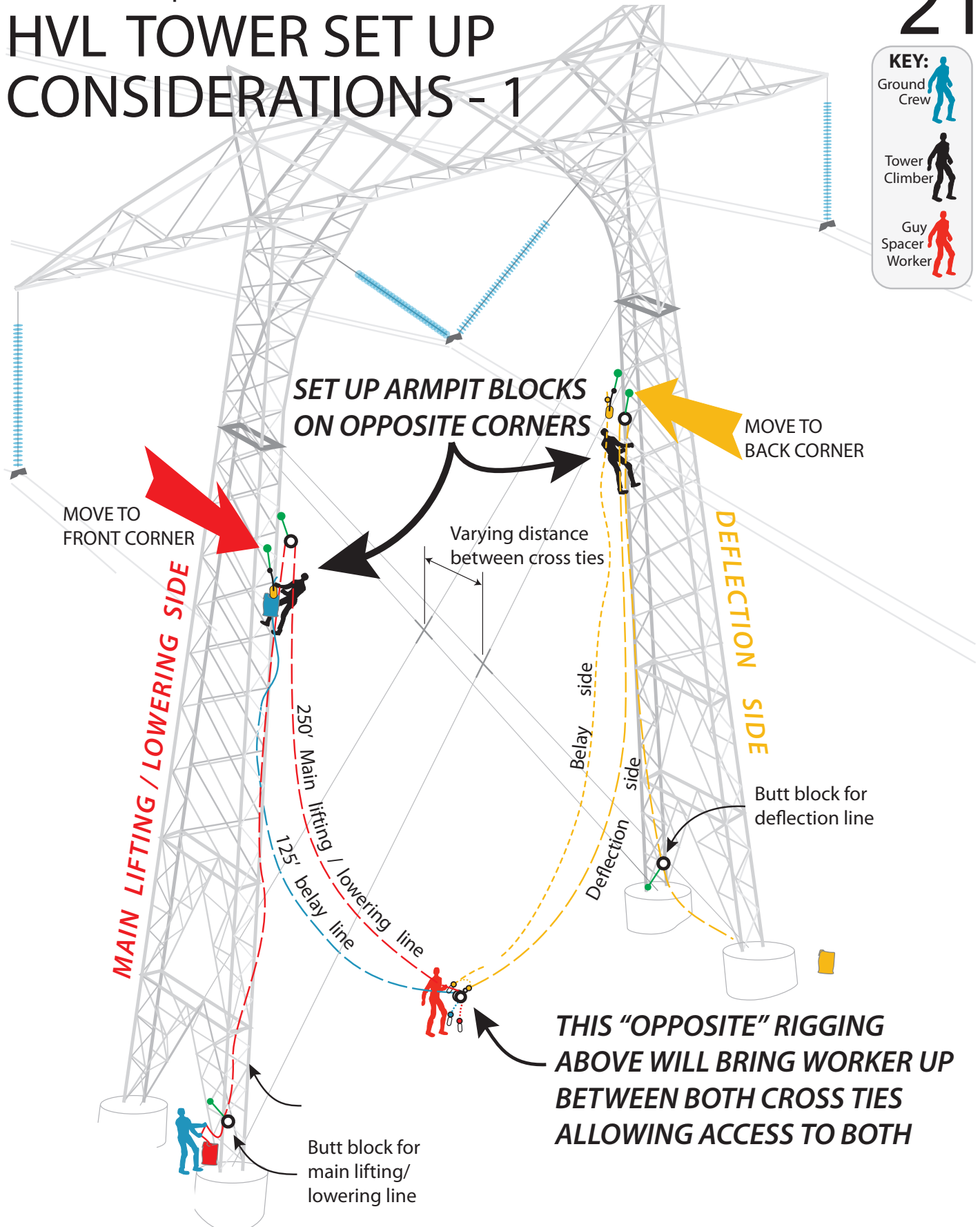
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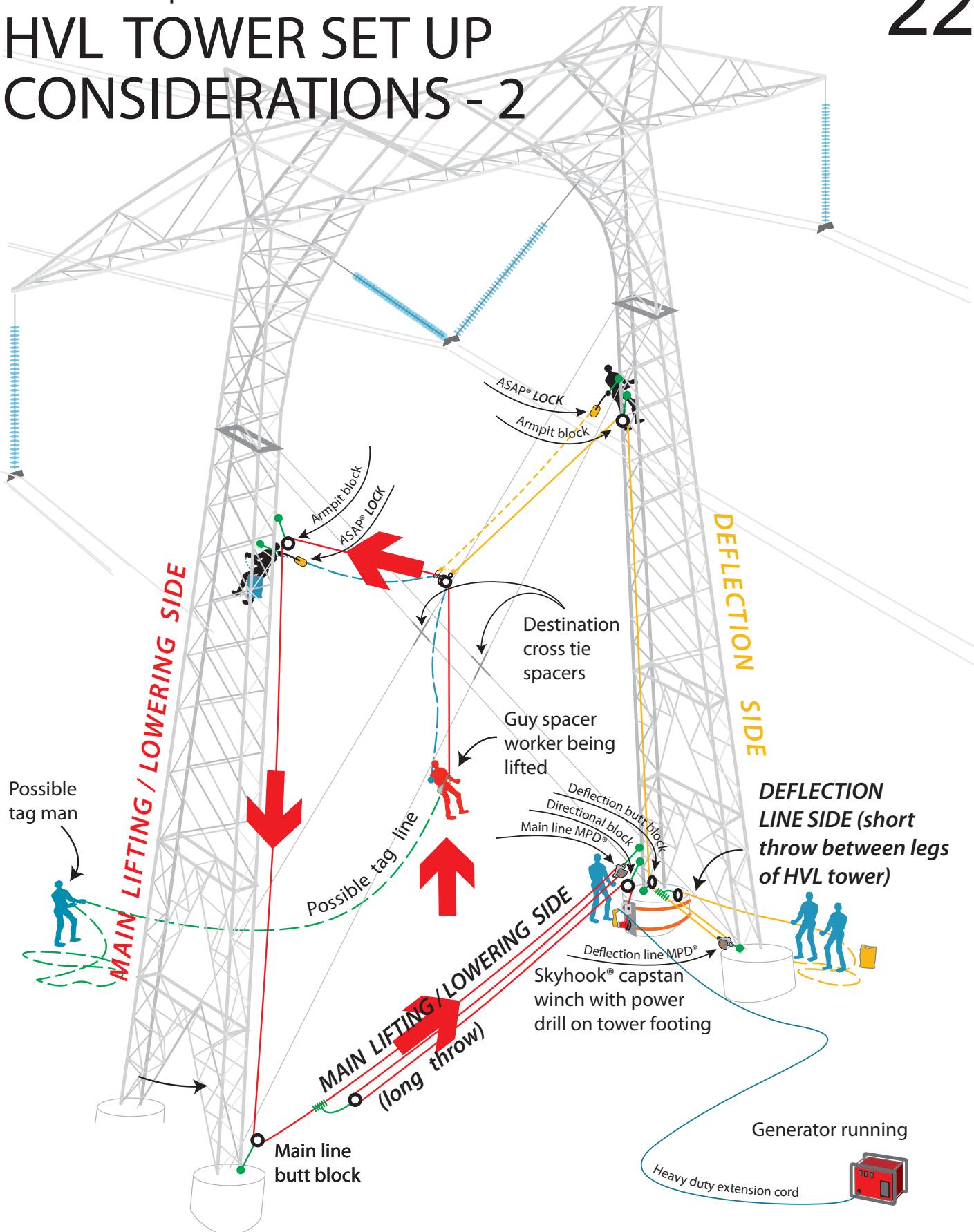
Ground Crew

Tower Climber

Guy Spacer Worker



HVL cross tie pre-form maintenance: HVL TOWER SET UP CONSIDERATIONS - 2

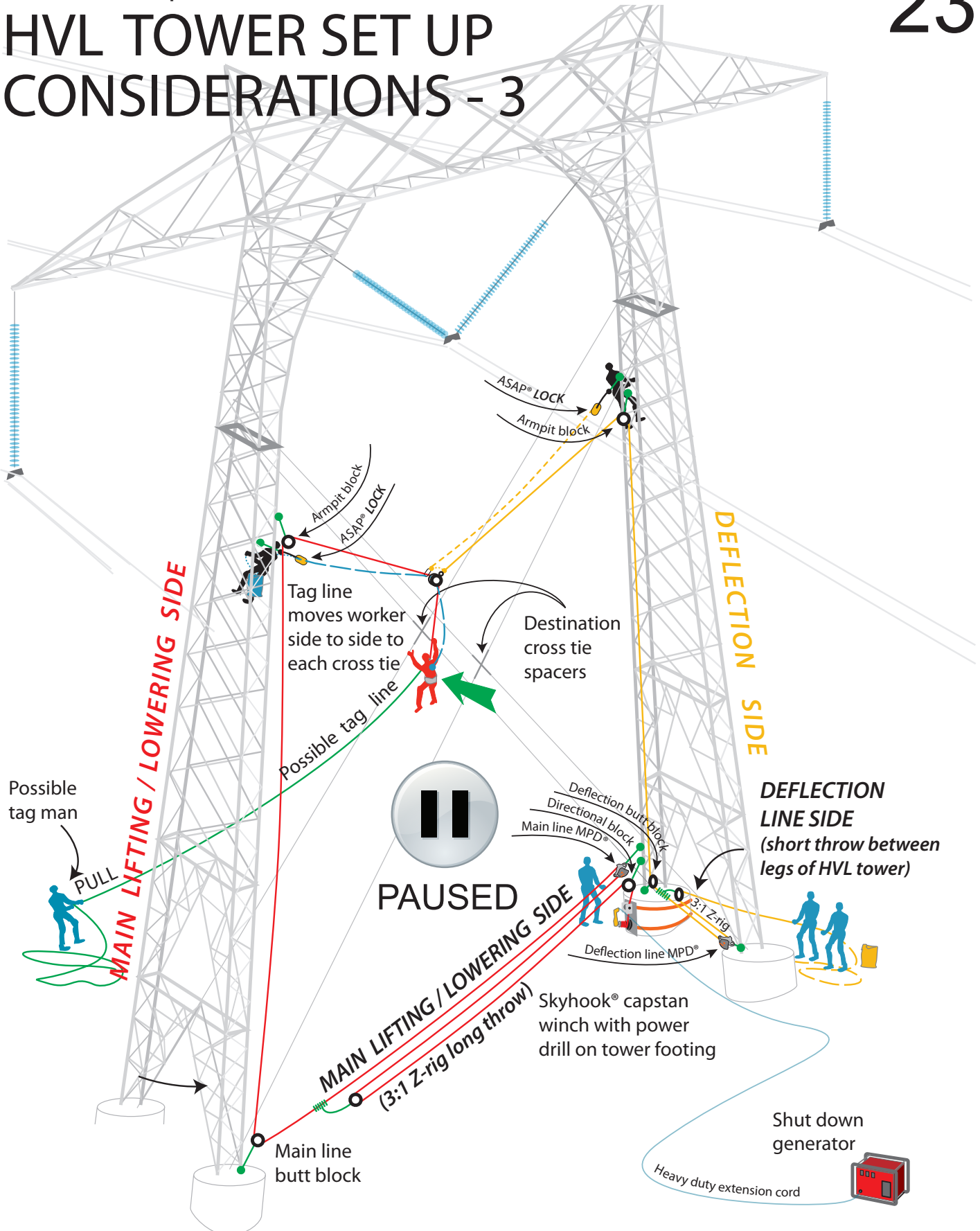




HVL cross tie pre-form maintenance:

HVL TOWER SET UP CONSIDERATIONS - 3

23



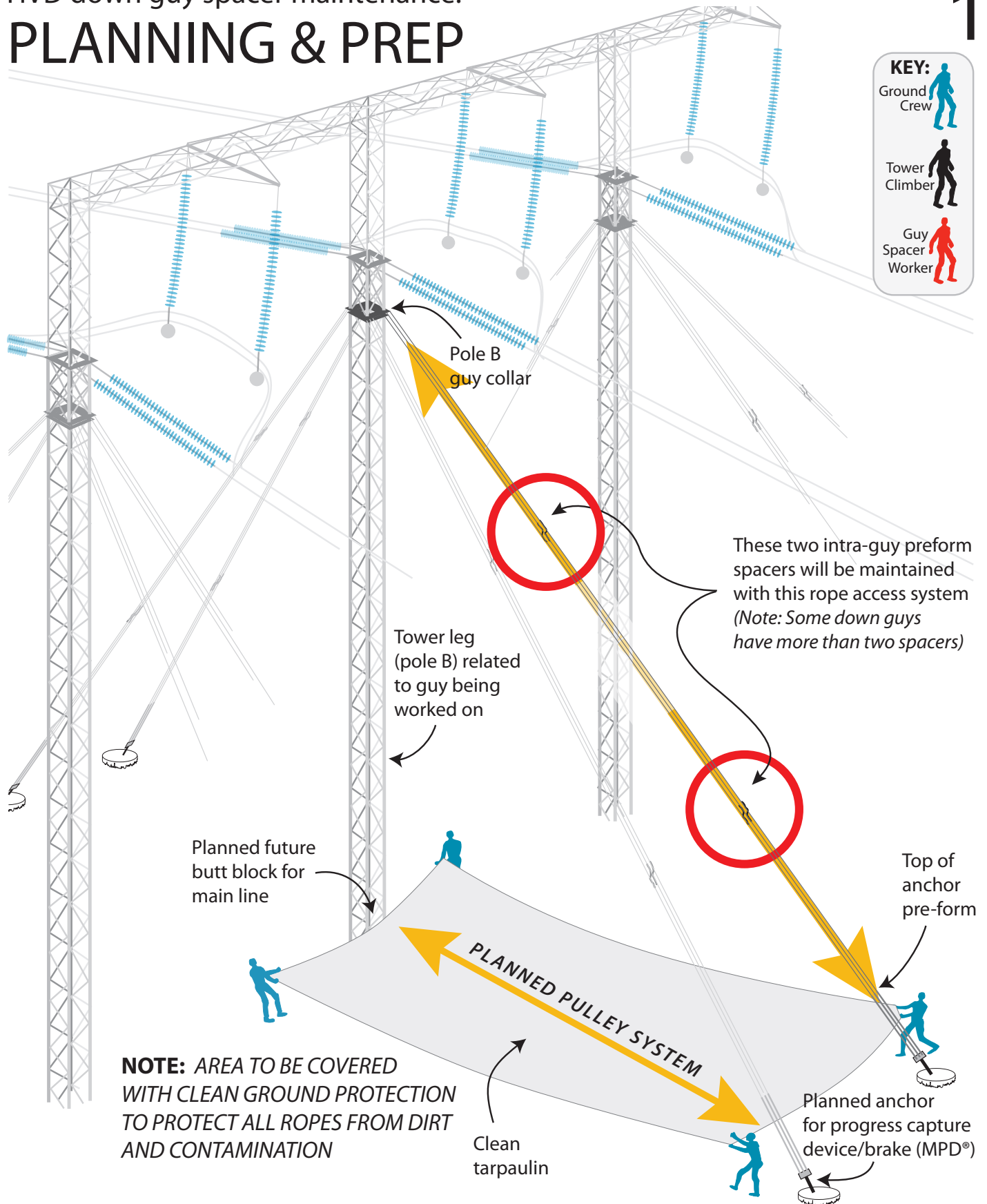


2.2.B HVD DOWN GUY SPACER MAINTENANCE



HVD down guy spacer maintenance: PLANNING & PREP

1



HVD down guy spacer maintenance: LAYING OUT ROPES

2



Climber readies himself for ascending tower with made up main lifting/lowering line and also upper end of belay line.

Note: May also hang hand line and pull all ropes and gear to the topmost position below guy collar

Make up end of belay line (blue) with double overhand stopper knot
Place ASAP® LOCK on rope, "UP" and arrow pointing away from stopper knot

Climber attaches armpit Omni Block® with bight of main lifting/lowering line to harness

This set of guys will be worked on

Belay rope bag (empty) carried up tower by climber

Temporary anchoring of both lines

Upper end of belay rope stacked at base of tower

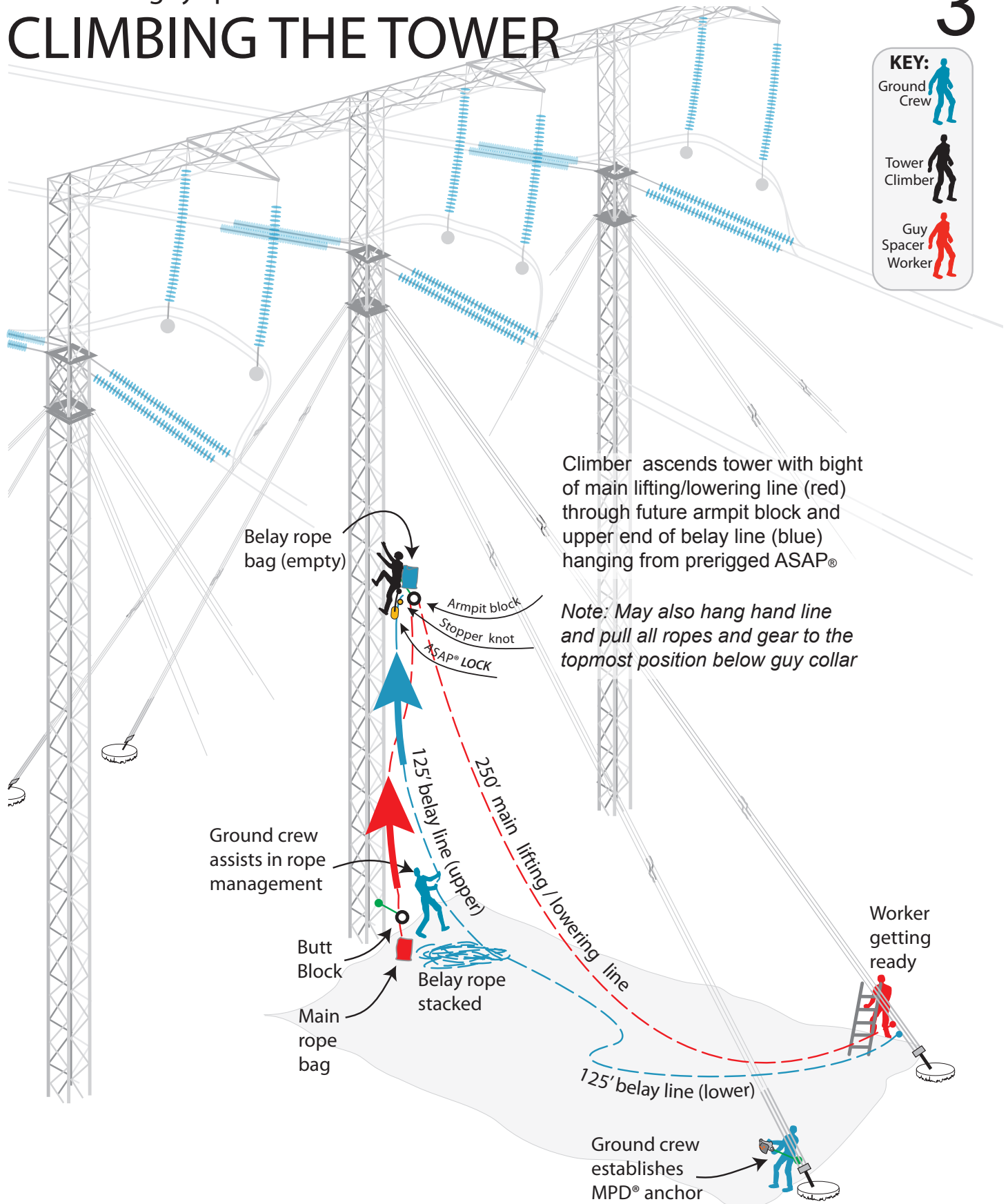
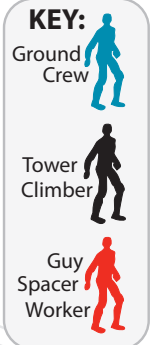
**KEEP ROPES ORGANIZED
WITH NO TWISTING!**



HVD down guy spacer maintenance:

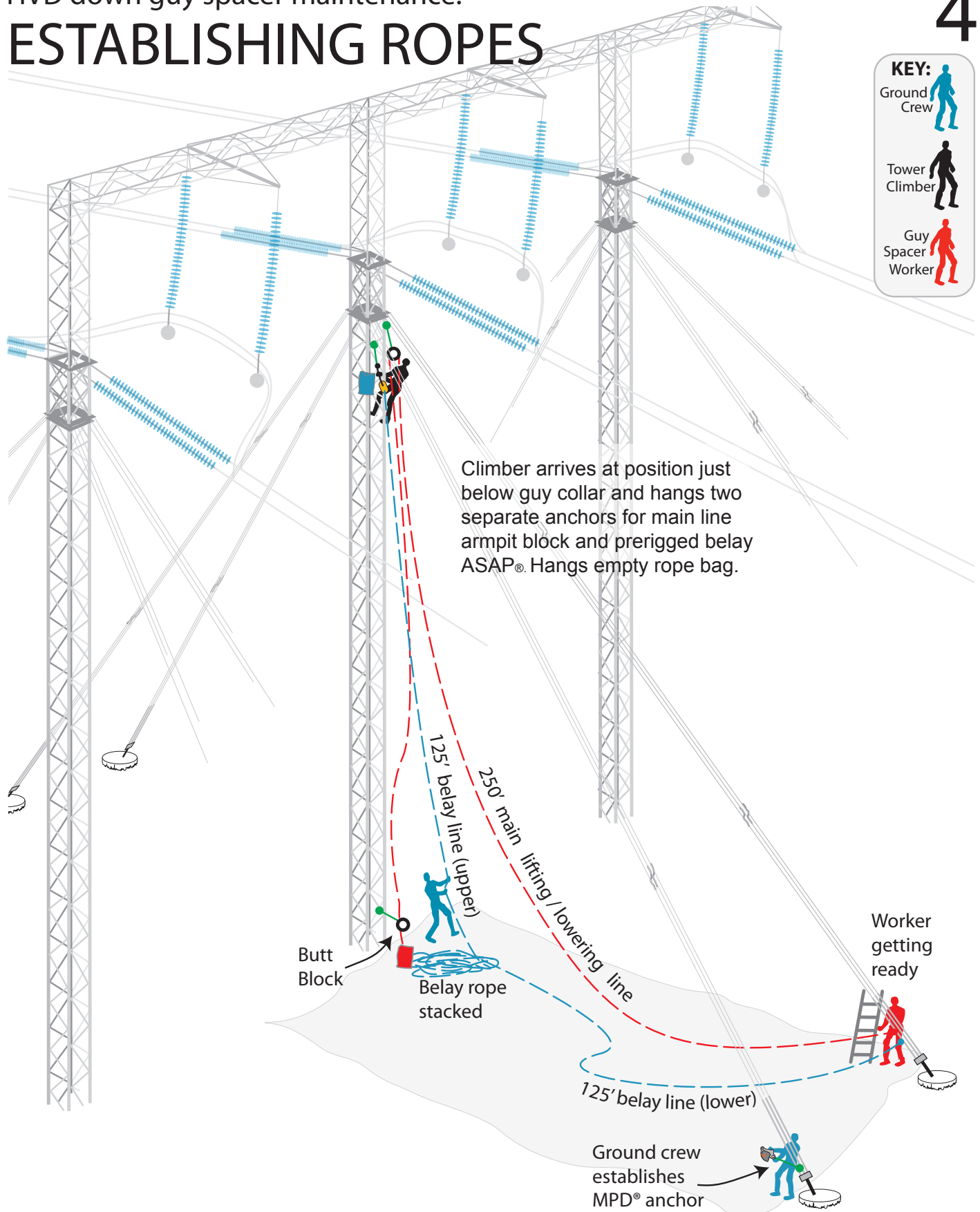
CLIMBING THE TOWER

3



HVD down guy spacer maintenance: ESTABLISHING ROPES

4

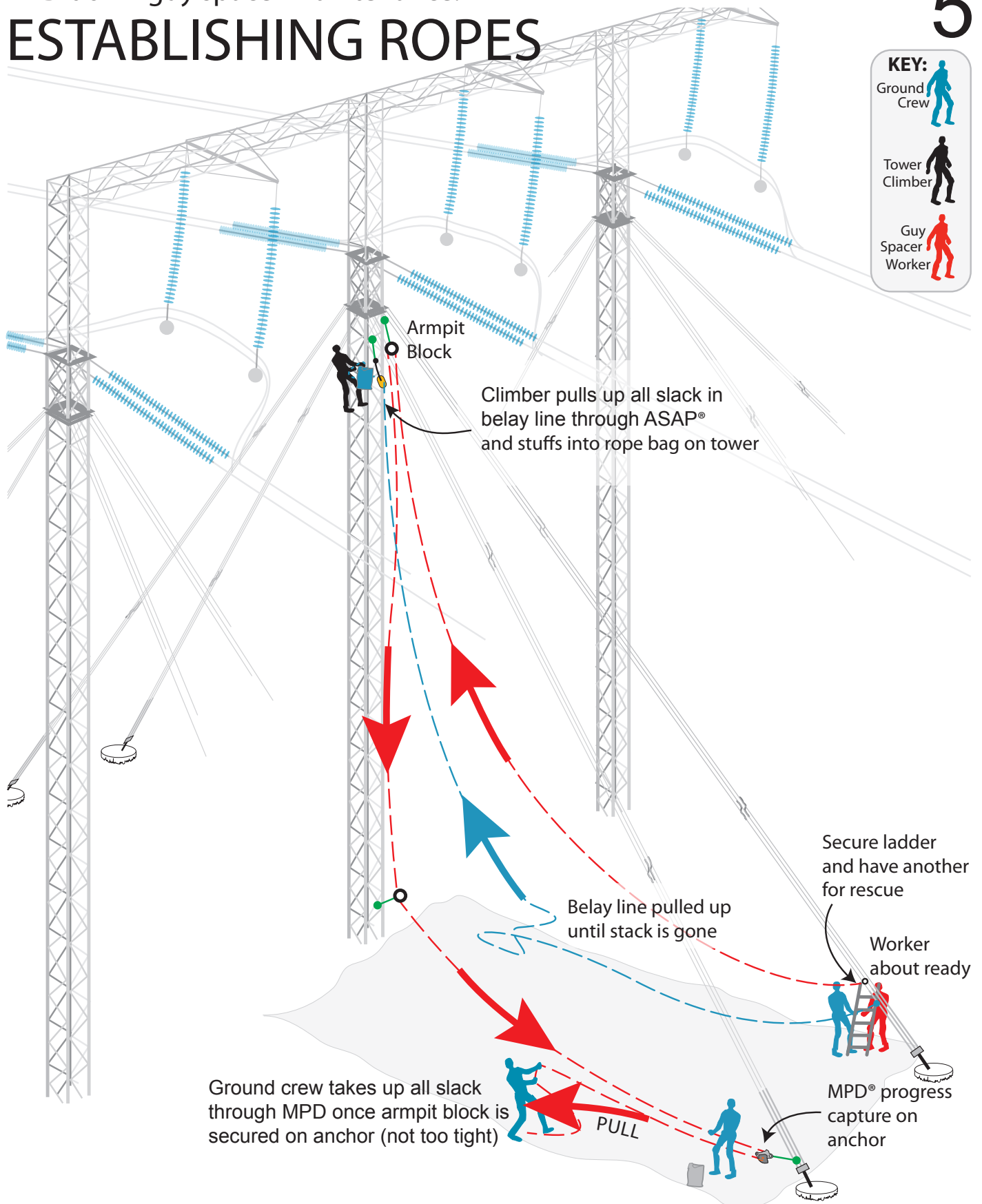




HVD down guy spacer maintenance:

ESTABLISHING ROPES

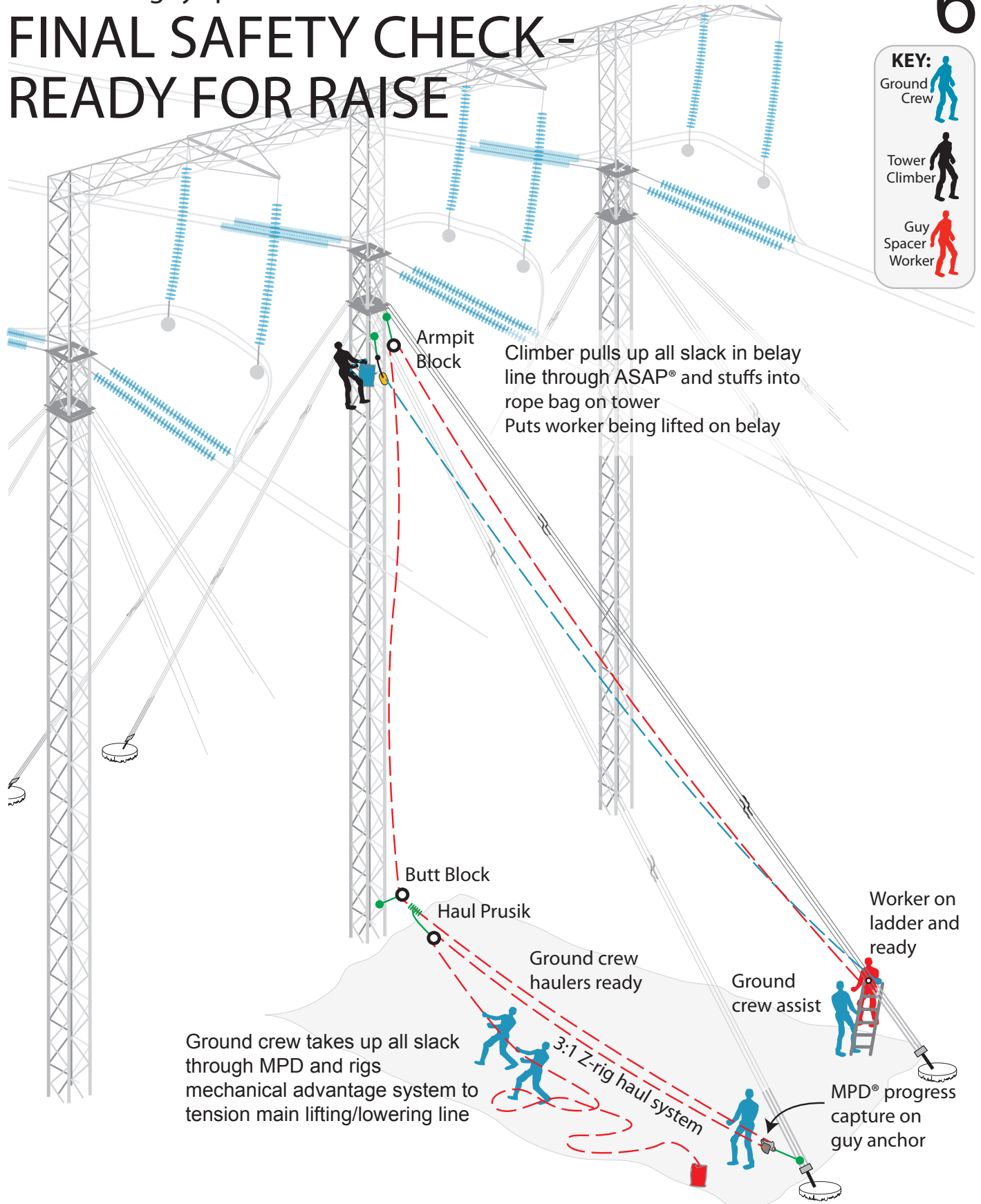
5



HVD down guy spacer maintenance:

FINAL SAFETY CHECK - READY FOR RAISE

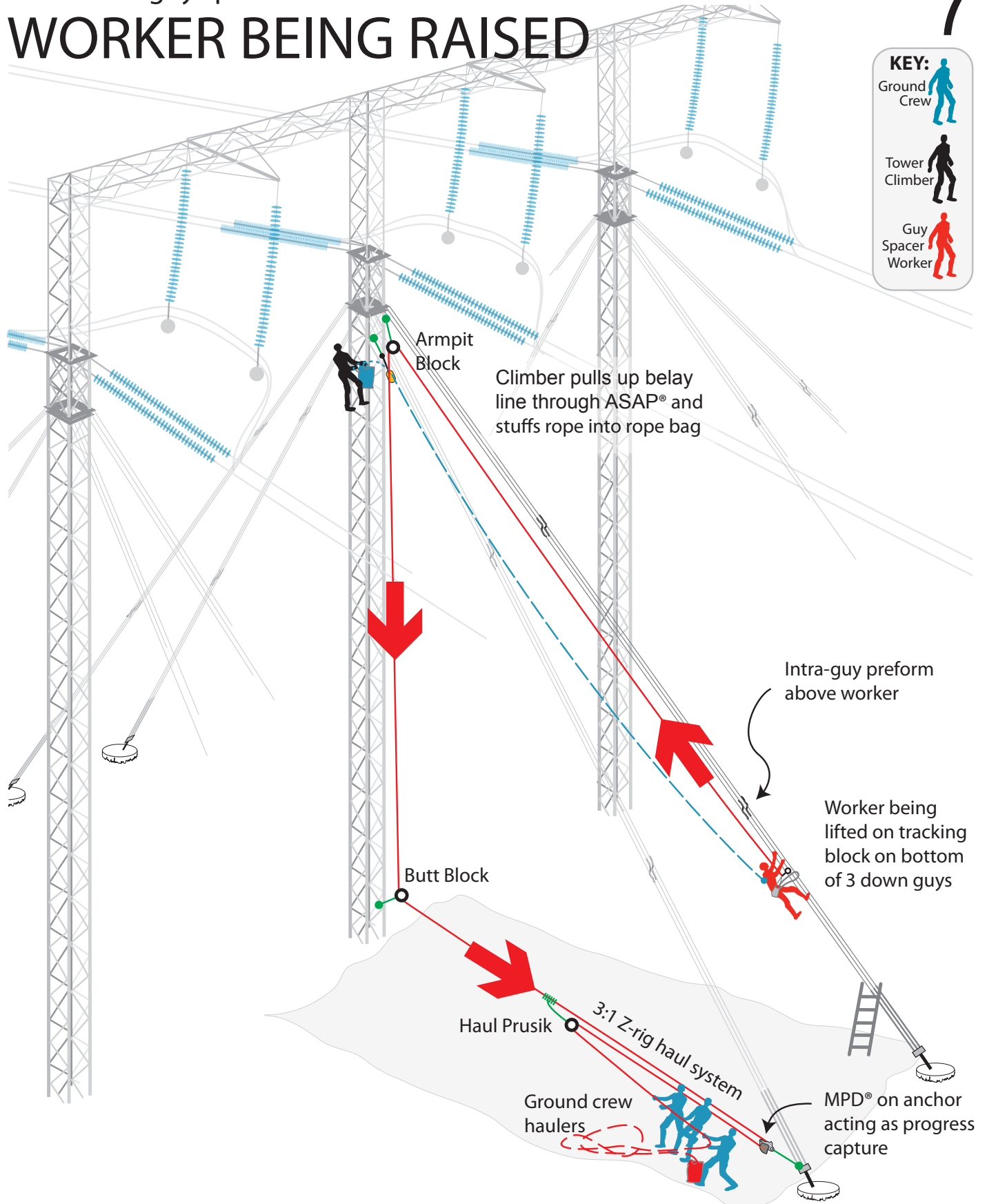
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HVD down guy spacer maintenance:

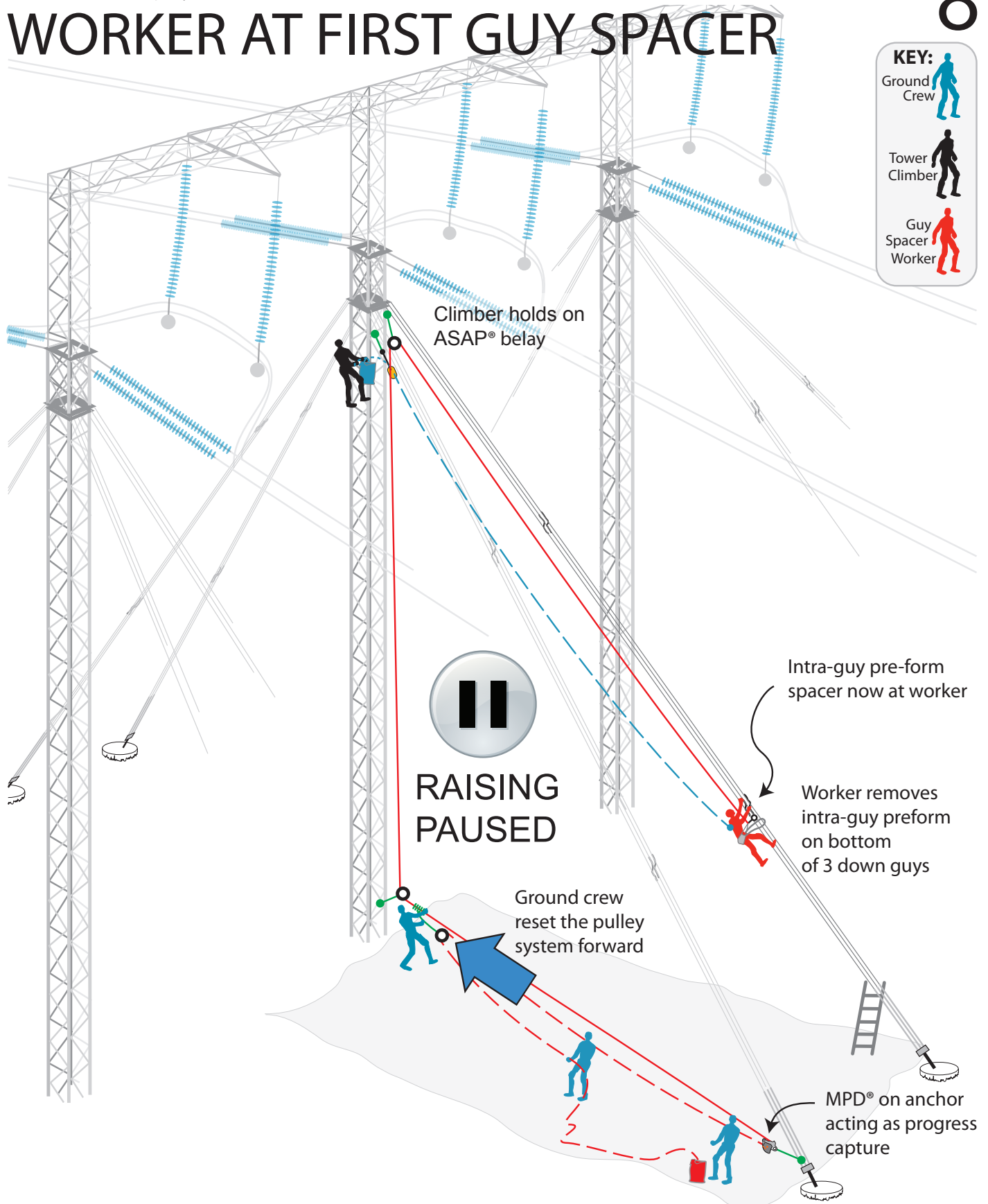
WORKER BEING RAISED



HVD down guy spacer maintenance:

WORKER AT FIRST GUY SPACER

8

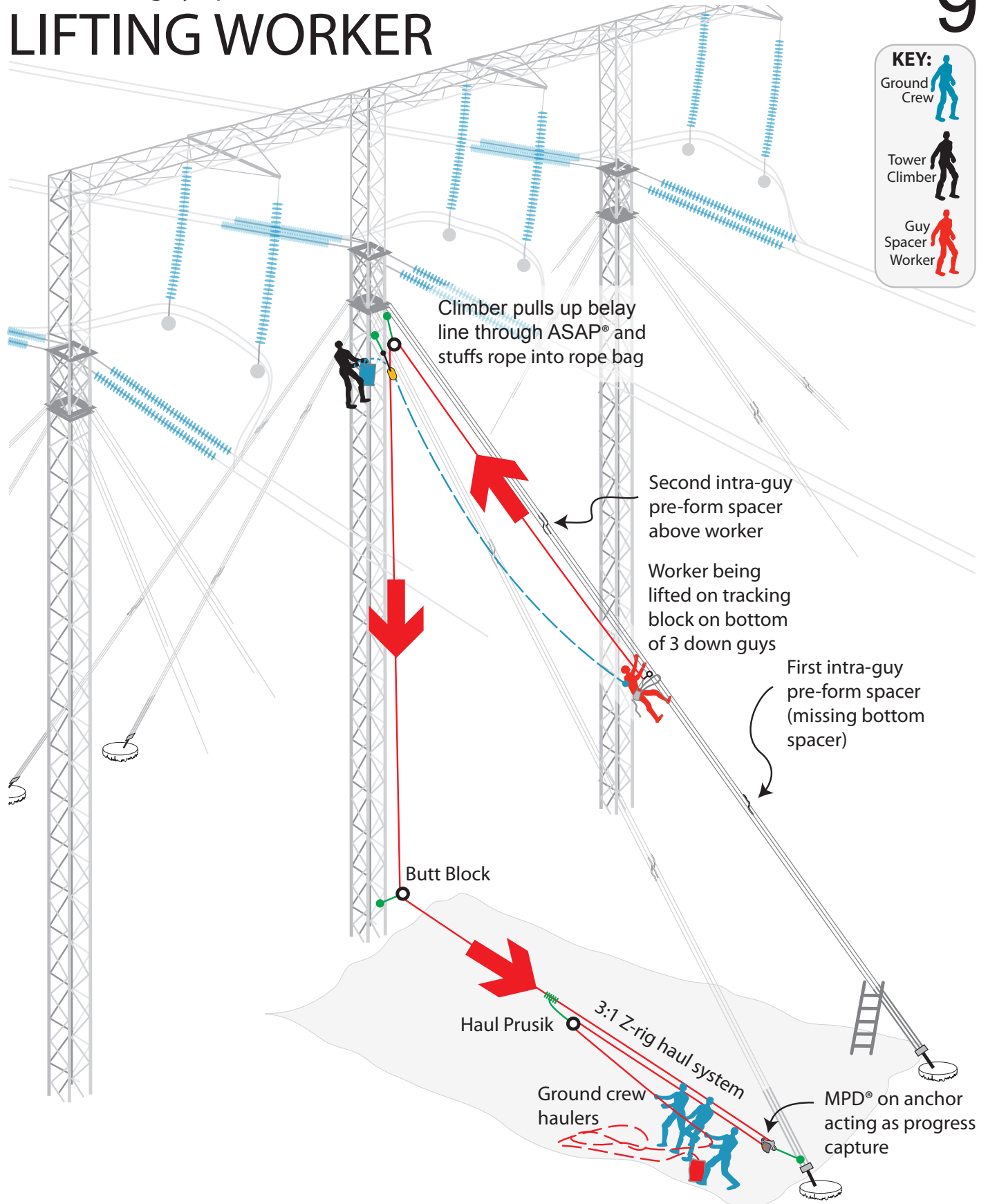




HVD down guy spacer maintenance:

LIFTING WORKER

9



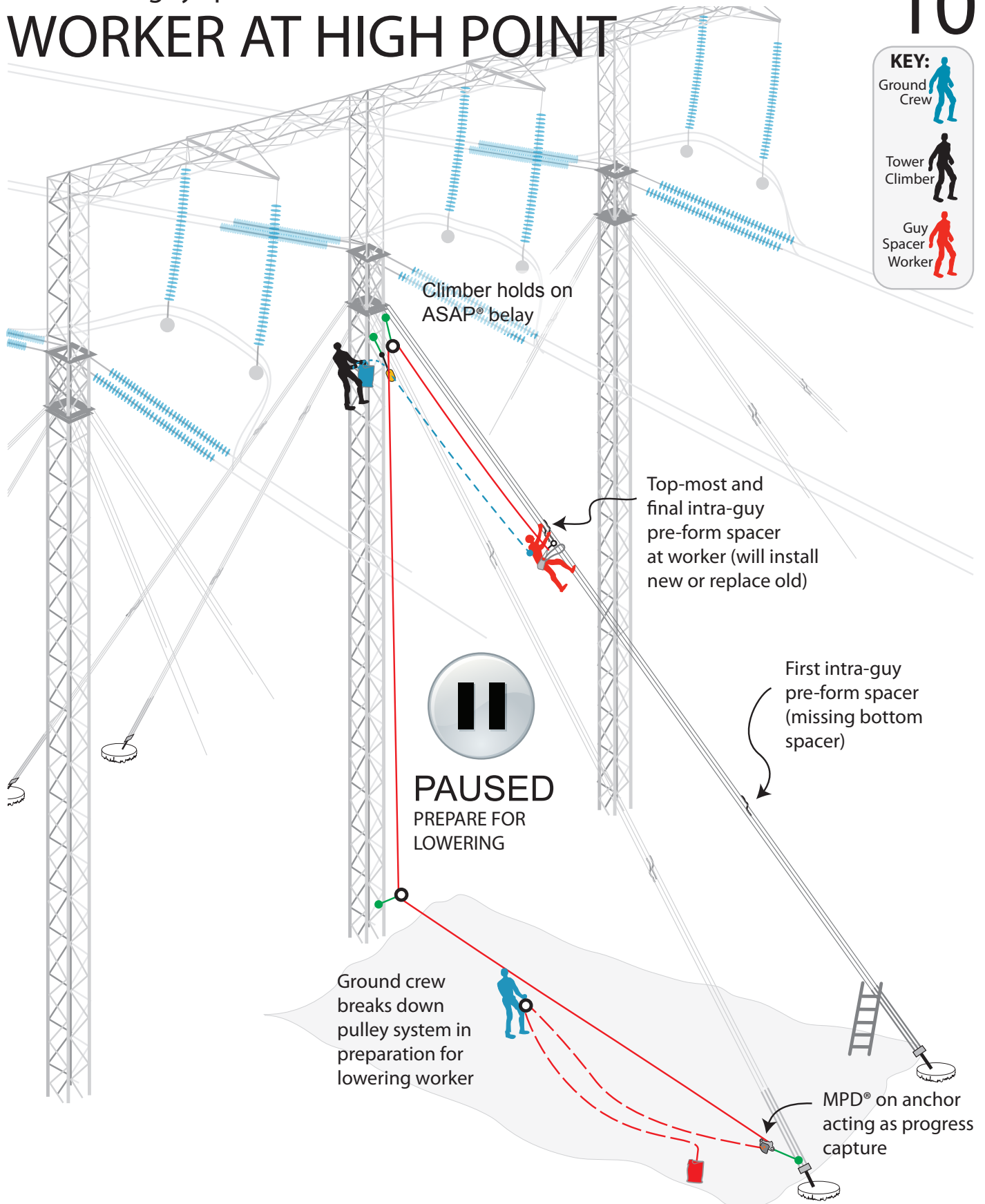


Appendix 2: Illustrations

HVD down guy spacer maintenance:

WORKER AT HIGH POINT

10





HVD down guy spacer maintenance:

LOWERING WORKER**11****KEY:**

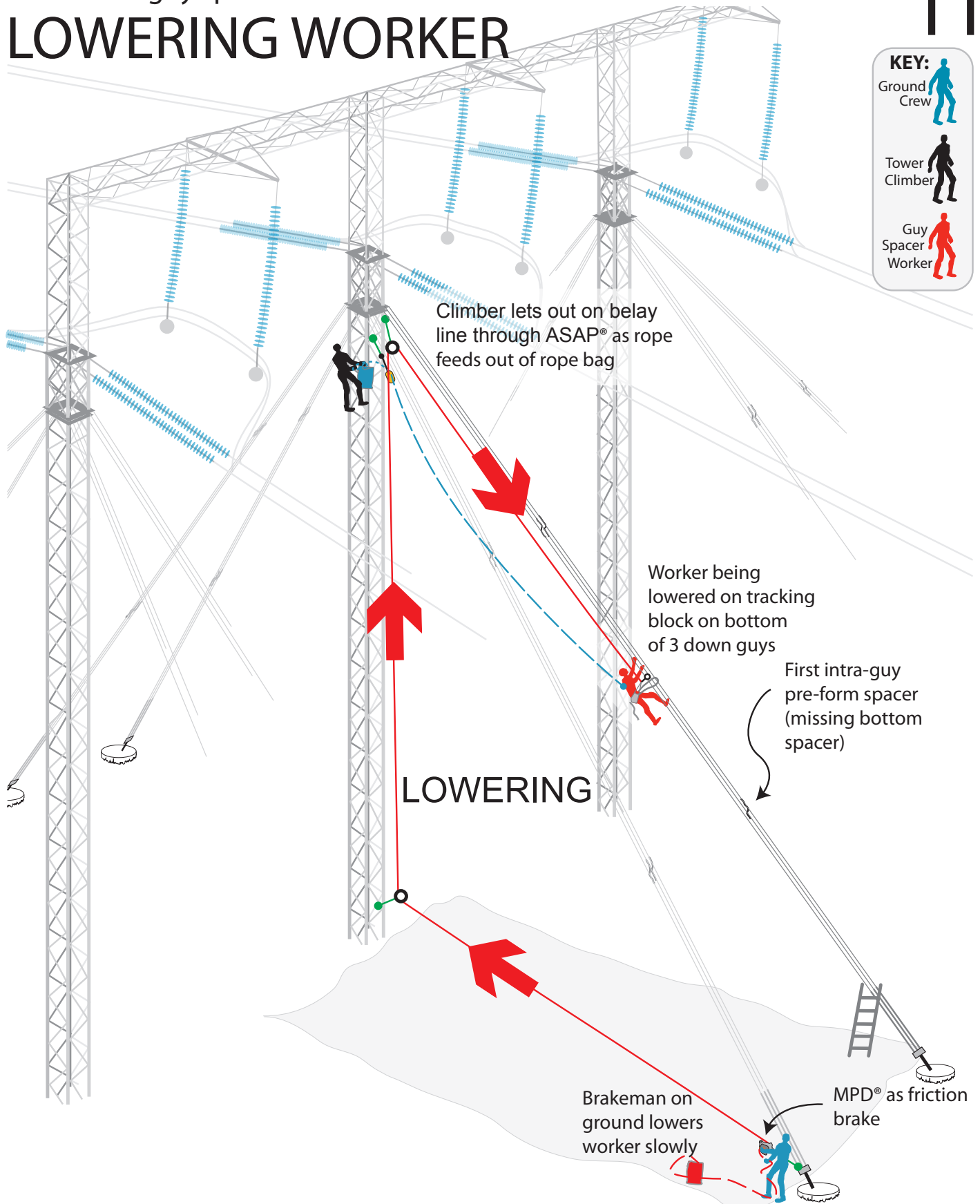
Ground Crew



Tower Climber



Guy Spacer Worker





Appendix 2: Illustrations

HVD down guy spacer maintenance: PLANNING

12

KEY:

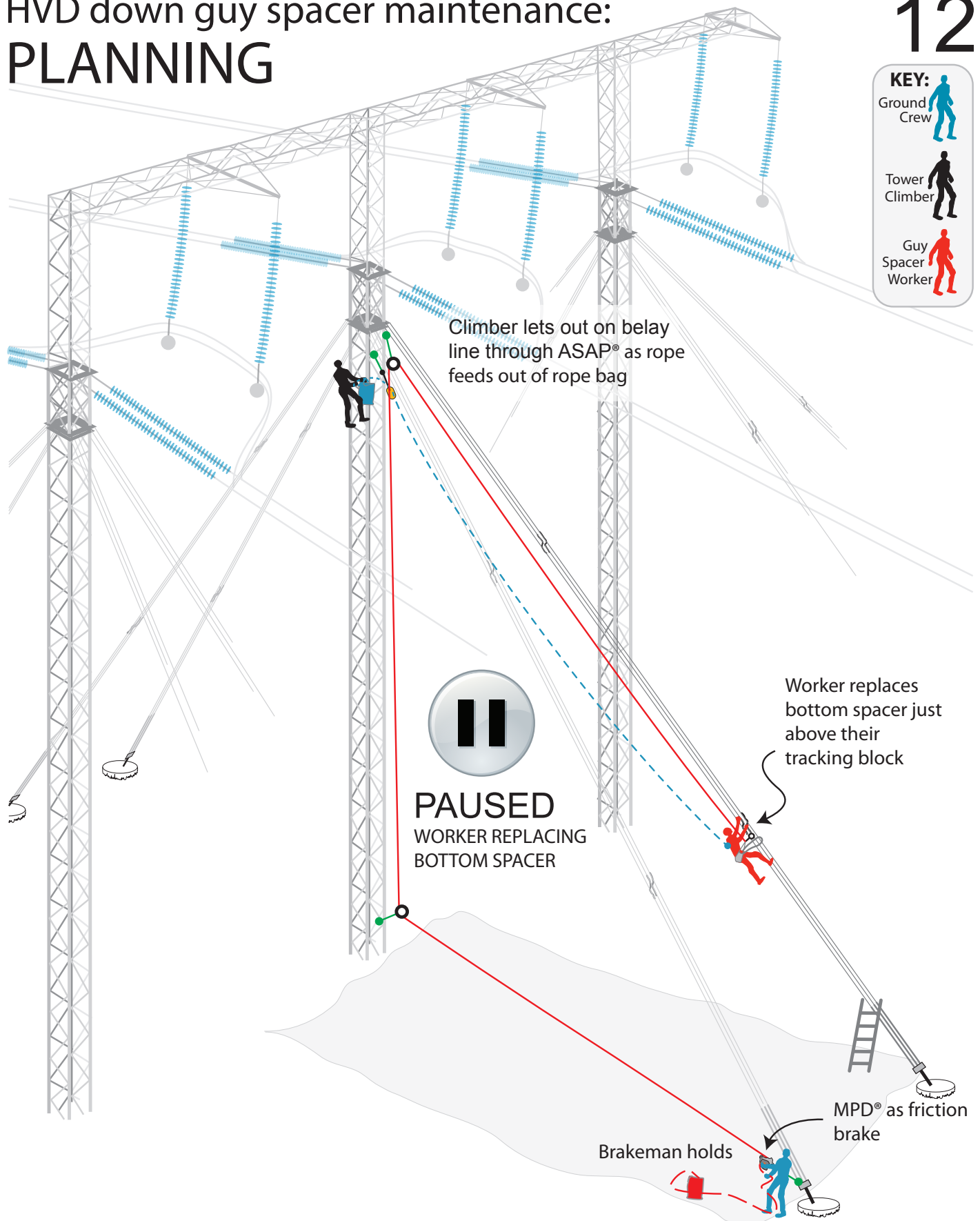
Ground Crew



Tower Climber



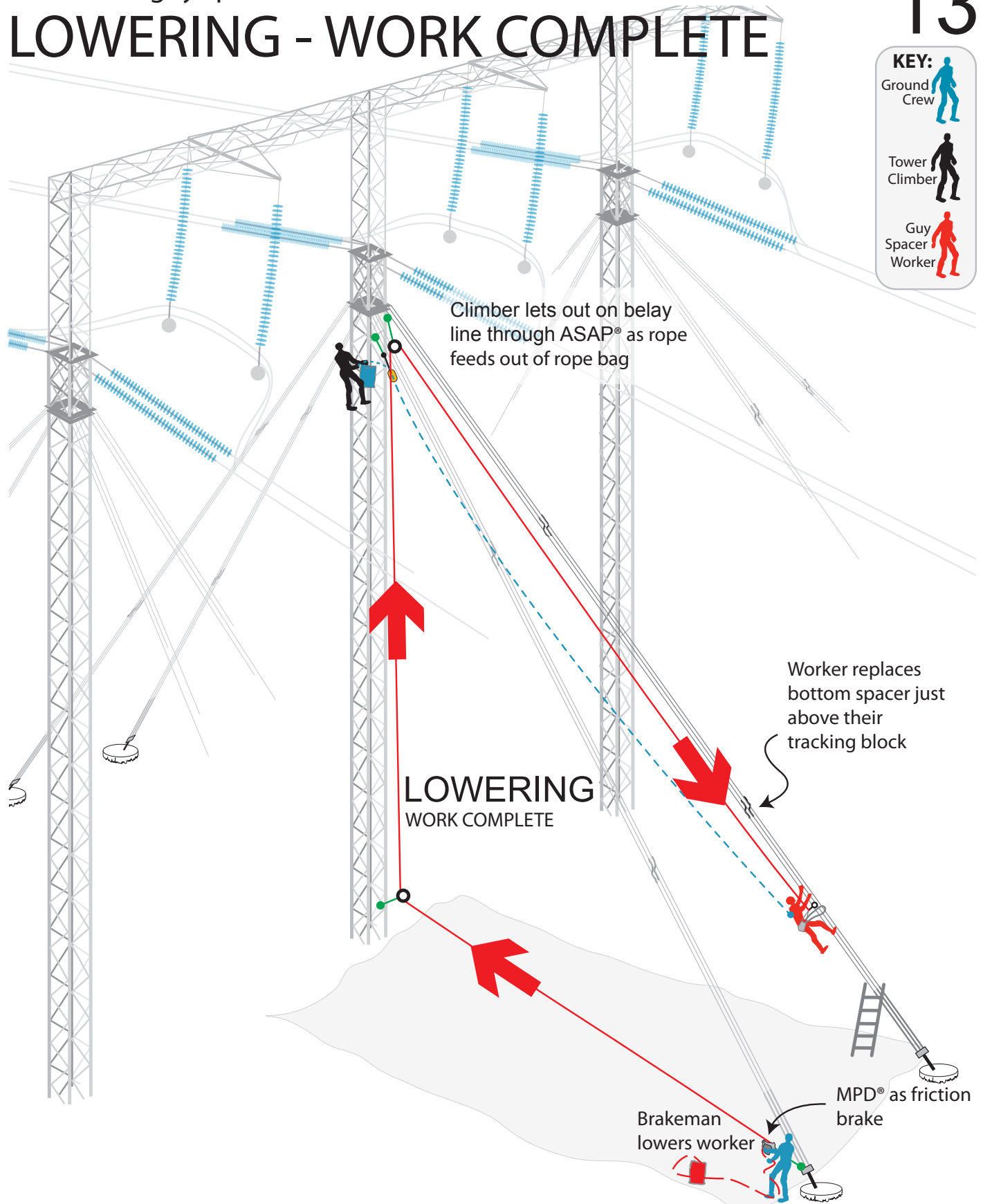
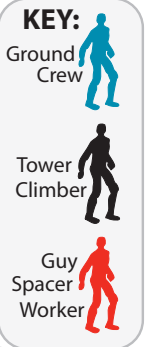
Guy Spacer Worker



HVD down guy spacer maintenance:

LOWERING - WORK COMPLETE

13



HVD down guy spacer maintenance: SAFE ON GROUND

14

KEY:

Ground Crew



Tower Climber



Guy Spacer Worker



Once worker is on the ladder or platform, the belay may be terminated

SAFE ON GROUND
WORK COMPLETE

Repaired or replaced intra-guy pre-form

Worker safe on ladder or platform

Ground crew assist

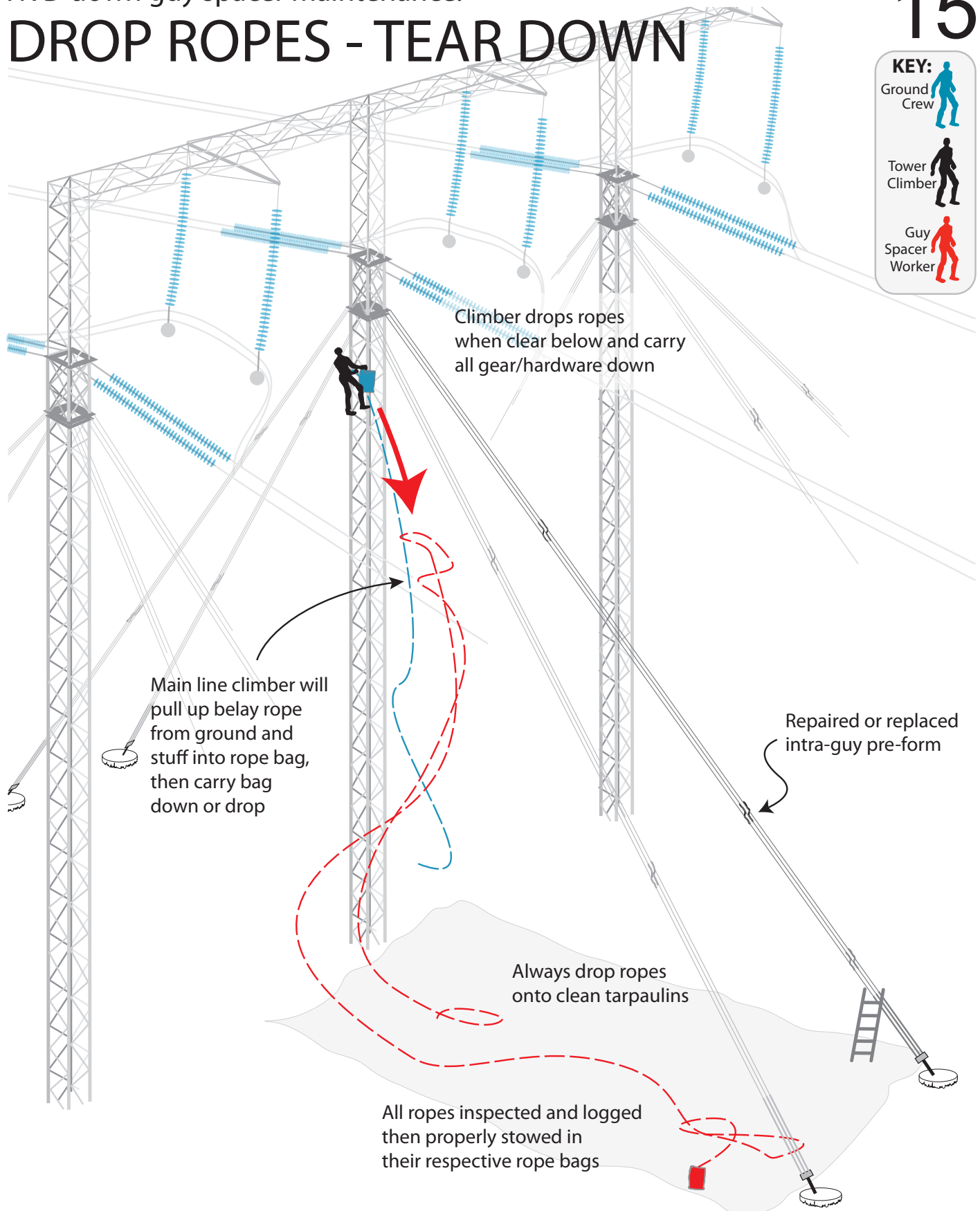
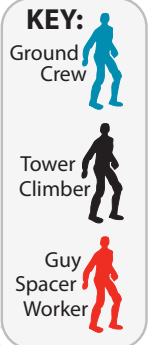
Brakeman ready to give slack in main line



HVD down guy spacer maintenance:

DROP ROPES - TEAR DOWN

15





Appendix 2: Illustrations