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MASTER OF MILITARY STUDIES

TITLE:

Operations GUNNERSIDE and GROUSE – Special Operations during World War II against the German Controlled Heavy Water Plant in Norway.

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF MILITARY STUDIES

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Executive Summary

Title: Operations Gunnerside and Grouse – Special Operations during World War II against the German Controlled Heavy Water Plant in Norway.

Author: Major Frode Kristoffersen, Norwegian Army, United States Marine Corps Command and Staff College.

Thesis: The operations were a success due to their execution by Special Operations Forces, which demonstrated that a small, select group of individuals with specialized training and thorough preparation could succeed where a conventional force could not.

Discussion: The production of heavy water at the German controlled plant at Vemork, Norway was essential for Hitler's nuclear research and development of a nuclear capability during World War II. German plans for tripling the production in 1942 made the Allies fear that Hitler was about to win the race for the atomic bomb, and Churchill prioritized the destruction of the heavy water plant.

In 1942, British plans for a commando raid at the heavy water plant included the reconnaissance party, Operation Grouse, formed by four Norwegians from Special Operations Executive (SOE) and a glider inserted strike force, Operation Freshman, formed by combat engineers from 1st Airborne Division. After the tragic failure of Operation Freshman on 19 November 1942, SOE decided to leave Operation Grouse in place in order to function as a combined reconnaissance and advance party for a Special Operation, Operation Gunnerside.

After a total of four winter months of reconnaissance, waiting, and surviving in the mountains of Norway, Operation Grouse could finally link up with Operation Gunnerside on 23 February 1943. Together, these two patrol-sized missions successfully destroyed the heavy water production in February 1943, and were able to withdraw without firing a single shot.

The teams overcame the frictions represented by German forces and the harsh winter of 1942 to 1943 firstly as a result of mastering the operating environment. The teams formed by a total of ten Norwegians had all been through extensive selection and training and possessed excellent winter skills in addition to local knowledge. Secondly, preparations for the specific objective went on for months. These preparations enabled the two small teams of Operations Gunnerside and Grouse to infiltrate uncompromised into the objective and execute a surgical demolition of the most vulnerable part of the heavy water production. Furthermore, the thorough preparations ensured flexibility when the teams had to adjust their plan and resulted in a flawless execution.

The third main reason for the success of Operations Gunnerside and Grouse is the ten soldiers' strong motivation for their mission. The soldiers faced high risks during the strike and Operation Grouse overcame extreme hardships during their prolonged mission in the snowy mountains.

Conclusion: Operations Grouse and Gunnerside achieved an outcome of strategic importance when they destroyed the heavy water production at Rjukan in February 1943, in an environment that proved too challenging for a conventional approach. The small group of specially selected soldiers capitalized on the soldiers' specialized training, skills, and preparations as well as their unique motivation for solving the mission in their occupied homeland.

Preface

During my studies of the amazing operations against the heavy water plant at Vemork in 1942 to 1943, I received the sad news that two of the participants had died, of natural causes. Knut Haugland died on Christmas day 2009 at the age of 92. It was the end of a remarkable life, including the Kon Tiki expedition where he crossed the Pacific in a primitive balsa boat as an archeological and social experiment. Jens Anton Poulsson, a retired colonel and regimental commander, died on 2 February 2010. Both had lived long and remarkable lives, and I am especially excited about the story of their 4 month long reconnaissance mission before the strike at Vemork.

Furthermore, the more I study the Vemork operations, the more I realize the striking similarities with current theories of special operations. I have studied two modern theories of Special Operations during my research. The authors of these theories did not study the operations at Vemork when developing their theories. Nevertheless, the two team leaders, Poulsson and Joachim Ronneberg of Special Operations Executive, executed operations that comply with current theories. Operations Grouse and Gunnerside were textbook Special Operations carried out in challenging terrain and weather, despite the presence of an overwhelming German force.

I had the honor to interview Poulsson during my studies and I also received input from Ronneberg. These inputs from primary sources have proven immensely valuable for my work, and I am forever thankful to them both for so willingly sharing their experiences.

I would like to thank my family for their patience during my long work hours, not to mention during my numerous deployments that have triggered my interest for the history of Norwegian SOF. My wife Chamilla's support during my studies has been fantastic, including her lessons for me on the theory of Case Study Research.

I would also like to thank Dr Gelpi, LTC Lewis, and LTC Lunde of USMC Command and Staff College as well as Patrice, Kathleen, and Andrea at the library for their important contribution to this paper. Furthermore, a great thanks to Eirik, Trond, and Tomas from NORASOC, LTC Johansen from the Norwegian Staff College, and Lars Jorgen for their support during my studies.

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Introduction

The small town of Rjukan, Norway and its fertilizer plant at Vemork, received the unlikely attention of Hitler, Churchill, and Roosevelt during World War II because of the race to develop the atomic bomb. German nuclear research relied on heavy water¹ and after the invasion of Norway in 1940 Hitler controlled Vemork, “the world’s only source of large scale production [of heavy water.]”² Thus, Vemork became a target of strategic importance. Although scientists in the United States did not use heavy water as part of their nuclear research, the Allies’ assumption was that it was necessary to shut down the plant in order to halt German progress in their nuclear program.

In 1942, British plans for a commando raid at the heavy water plant included the reconnaissance party, Operation GROUSE, formed by four Norwegians from the British Special Operations Executive (SOE), and Operation FRESHMAN, a glider inserted strike force from the British 1st Airborne Division. After the tragic failure of Operation FRESHMAN on 19 November 1942, SOE decided to leave Operation GROUSE in place for further reconnaissance in order to set conditions for a small-scale special operation, Operation GUNNERSIDE, conducted exclusively by Norwegians from *Kompani Linge* of SOE. (See annex A: Map Operations GUNNERSIDE, GROUSE, and FRESHMAN.)

Operations GROUSE and GUNNERSIDE were patrol-sized missions that together led to the successful destruction of heavy water production in February 1943. After four months of reconnaissance, Team GROUSE linked up with the parachute inserted Team GUNNERSIDE and conducted the strike at Vemork without firing a single shot. The small but highly motivated and skilled groups were able to overcome the frictions the operation faced and succeed in the strategically important mission of

destroying the heavy water production plant. Operations GUNNERSIDE and GROUSE were a success due to their execution by Special Operations Forces (SOF) which demonstrated that a small, select group of individuals with specialized training and thorough preparation could succeed where a conventional force could not.

An examination of Operations GUNNERSIDE and GROUSE demonstrate fundamental and timeless qualities of special operations in which a small unit can achieve strategic effect: furthermore, the two operations are highly relevant for current operations by providing guidance for SOF on the importance of quality in training, selection, and preparations. Operations GUNNERSIDE and GROUSE illustrate Robert Spulak's theory stating that the strength of SOF is primarily derived from the ability to "address the ultimate sources of friction."³ Today, SOF units need to master challenging operating environments in order to maintain their qualities as creative and flexible forces, to remain an alternative to conventional forces for missions of strategic importance similar to Operations GUNNERSIDE and GROUSE.

Current theories of special operations

Looking at Operations GUNNERSIDE and GROUSE through the special operations lens, two different views may explain the successful outcome of the operations. Admiral William H. McRaven's *SPEC OPS*, assesses principles that lead to success for a small force in an offensive operation, whereas Dr. Robert G. Spulak's essay "A Theory of special operations" focuses on the qualities of the personnel that are needed in order to succeed. These two positions complement each other and explain how Operations GUNNERSIDE and GROUSE achieved success.

McRaven's six principles for special operations are: surprise, speed, purpose, security, repetition, and simplicity.⁴ From eight special operations case studies, McRaven derived that the key to success is "a simple plan, carefully concealed, repeatedly and realistically rehearsed, and executed with surprise, speed, and purpose."⁵ By following these principles, SOF personnel are able to overcome the frictions of war if they also hold the "moral factors of courage, intellect, boldness, and perseverance."⁶

Spulak's theory is focused, as well, on overcoming friction in special operations but he contends that the attributes of SOF personnel are the key to success rather than principles of execution. Spulak focuses on attributes needed to overcome Clausewitzian friction as the key to achieve success.⁷ In *On War* Clausewitz defines friction to be "the force that makes the apparently easy so difficult."⁸ This paper uses Clausewitz' definition of friction and puts special emphasis on his further description of friction: the "countless minor incidents – the ones that you can never foresee – [that] combine to lower the general level of performance."⁹

In Spulak's view, the three vital attributes, or qualities, of SOF personnel are: "elite warriors, creativity, and flexibility."¹⁰ Through extensive selection and training, along with prioritizing quality over quantity, SOF units may create teams with personnel who possess these attributes to a larger extent than personnel in regular units. As a result, SOF teams may overcome friction to a larger degree than a conventional unit, which gives the SOF team a broader span of operational capabilities and fewer limitations.

Together, McRaven's and Spulak's theories demonstrate how a small SOF team of specially selected and trained personnel may achieve success. Where a conventional unit may be limited by the specific challenges of an operation, SOF units with special

skill sets may overcome these challenges and use them to their advantage (e.g. covert parachute insertion of a small team where the terrain limits movement of larger conventional forces). Moreover, the limited size of a SOF unit may also benefit the operation, since smaller teams have a better chance to avoid enemy surfaces, operate covertly, and achieve the element of surprise. As a result, a successful SOF team may bring to bear a superior relative strength by engaging the unprepared enemy with the advantage of initiative and precision targeting.

At Vemork, Operation FRESHMAN experienced severe challenges due to the terrain and weather in Norway. Conversely, the SOF operations depended on the terrain and weather in order to get to the objective without being compromised by the numerically superior German guard force. It was especially the SOF characteristic of *certain access* that proved to be vital for the success of SOE's operations at Vemork. As explained by Spulak, *certain access* is a SOF characteristic that enables SOF to operate in areas where conventional forces may not operate.¹¹ Thus, Operations GUNNERSIDE and GROUSE provide an excellent opportunity to validate McRaven's and Spulak's views. The strike at Vemork depended on adherence to all of McRaven's principles. Moreover, the members of the operation possessed the qualities needed for SOF personnel. Britain's SOE limited the total number of its operatives through selection, training, and preparations to ensure that they held those qualities listed by Spulak.

The Heavy Water Plant at Vemork

Before World War II Germany was a leading nation in nuclear research. Hitler needed large quantities of heavy water for his nuclear program, since German scientists used it for slowing down nuclear reactions during testing. Norsk Hydro led the world in

the production of heavy water by 1940, as a by-product of its fertilizer production at Vemork. After the invasion of Norway on 9 April 1940, German forces controlled Vemork and heavy water production. German plans for tripling heavy water production in 1942 led the Allies to conclude that Hitler was close to winning the race to create an atomic bomb.

Based on the assessment of Hitler's progress,

the British War Cabinet, approached Combined Operations Command with an urgent request that Vemork be attacked with sufficient force to destroy all accumulated stocks of heavy water, the major pieces of machinery in the electrolysis plant used for its production, and the power station situated at the rear of the plant.¹²

Combined Operations Command examined six different courses of action for the mission.¹³ All six were considered high risk for the force involved except for the option of bombing the plant; nevertheless, plans for bombing Vemork were soon abandoned. With the plant situated in a steep and narrow valley, Combined Operations Command concluded that there was a low probability of hitting the target. As the most important part of the production facility was underground even a precise hit would mean only a short delay in heavy water production. Moreover, the risk of collateral damage if stray bombs hit the populated area of Rjukan and its highly explosive liquid-ammonia storage tanks mitigated against bombing.¹⁴

Operations GROUSE, FRESHMAN, and GUNNERSIDE

Under pressure from the War Cabinet to find a solution, Combined Operations Command developed Operation FRESHMAN to destroy the heavy water production plant at Vemork. The plan was to insert two groups of Army engineers from 1st Airborne Division by gliders. The glider insertion would allow the groups to avoid the

concentration of German soldiers in the town of Rjukan and attack the small guard force at Vemork directly. The two groups were to demolish the underground processing plant and, if possible, also the electrical plant.¹⁵ Combined Operations Command chose engineers for the operation because of the importance of the demolition job. Only well placed charges would do substantial damage to the robustly constructed heavy water plant. The two 12-man teams constituting Operation FRESHMAN were all volunteers who had little or no knowledge about the importance of the operation. When British Combined Operations Command saw the need for a reconnaissance party for Operation FRESHMAN, it turned to SOE to employ Norwegian operatives with local knowledge and winter skills.

The reconnaissance part, codenamed Operation GROUSE, was given the mission to reconnoiter and prepare a landing strip, receive the gliders, and guide the strike force to the objective. SOE appointed a four-man team of Norwegians, all born in Rjukan, for the mission. On 17 October 1942, Operation GROUSE parachuted into the snowy mountains of Norway, but landed miles away from the planned drop zone. This put them a considerable distance from the objective. Despite heavy challenges due to the faulty parachute drop, communications issues and bad weather, the Norwegian SOE operatives were ready to receive the British engineers during a favorable moon phase one month later.

On 19 November 1942, the GROUSE team's month of preparations proved to be in vain when Operation FRESHMAN failed. Weather conditions during the night of the insertion led to fog and icing on the two gliders and the Halifax planes towing them. One plane crashed still towing the glider and the other plane was forced to release the glider in

the blind before returning to England. All three crews from the two gliders and the crashed plane were killed. The majority died during the crash landing; nevertheless, German soldiers captured and killed the few survivors. The execution of these British soldiers was the main reason for the British condemnation of General Falkenhorst, the German commander-in-chief in Norway, as a war criminal after World War II.¹⁶ For Operation GROUSE, the tragic end of the forty-one British soldiers was not known but the team assumed that Operation FRESHMAN failed.

Despite the loss of the engineer contingent, SOE decided to maintain the GROUSE team as a reconnaissance and advance party for a new operation, Operation GUNNERSIDE.¹⁷ The new operation would be carried out solely by SOE and *Kompani Linge*, as SOE “felt there was a chance of success using clandestine methods.”¹⁸

Operation GUNNERSIDE depended upon maintaining the GROUSE team in country and the four-man patrol stayed put. They lived off the land for the next three months and experienced several delays when bad weather during the favorable moon phases did not allow for the parachute-insertion of Operation GUNNERSIDE.¹⁹

Finally, on 23 February 1943, the two teams linked up. The combined group numbered a total of ten Norwegians,²⁰ predominantly from the local area. After coordination and consolidation of the final plans, the ten-man team carried out the strike on the night of 28 February. By infiltrating via steep terrain and armed with knowledge of the German guard routines, the team entered the heavy water plant and placed explosive charges without being compromised. The team executed the operation successfully without firing a shot and exfiltrated the Vemork area. From their mountain operating base, the team started their extraction by skis to Sweden, a journey of approximately 400

kilometers²¹ that they made in fourteen days. From neutral Sweden, the group returned to England via airplane.

While Operation FRESHMAN failed during insertion and proved the military challenges of attacking Vemork, the success of SOE's operations demonstrated that SOF was best suited for achieving Allied objectives at this strategically important target located in "some of the most dangerous and inhospitable terrain known to man"²² and heavily occupied by German troops.

Selection and Training

Winston Churchill established SOE in 1940 in order to train resistance movements and carry out operations in German occupied countries. Norwegians serving in SOE were organized in Norwegian Independent Company Number 1, later named *Kompani Linge*, after the company commander. Captain Martin Linge was killed in the December 1941 Maaloy Raid. British forces had to start from scratch when establishing SOE, and experienced several setbacks while building the unit under fire. Despite such an inauspicious start for SOE, by 1942, when Colonel John. S. Wilson was appointed the head of the Norwegian section, "its great potentialities were becoming clear,"²³ and the unit became a true SOF unit even when evaluated by twenty-first century criterion.²⁴

According to Spulak it is important that SOF units emphasize selection and training of personnel with the right qualities. SOE sent their Norwegian recruits through a series of selection and training programs before the most talented made it to the operations branch. Undesirable recruits were sent to other military units, and, as the British author Ray Mears put it in his description of the selection process, "it was surprising, given the desperate need for recruits, how ruthless SOE were in culling the

numbers.”²⁵ SOE understood that quality had to be prioritized in building a SOF unit. By thorough and varied selection and training programs, SOE officers ensured that the operations branch only consisted of operatives who were able to adapt and learn during various challenges. As Spulak would characterize SOF operators, SOE operatives held the qualities needed to overcome friction; they were creative and flexible elite warriors.

Selection and training took place in England, but getting there was a test of determination and will in itself. Due to the German occupation of Norway, getting to England was a challenge for most Norwegians who volunteered to fight the German occupation force. SOE recruited some Norwegian members in Sweden and were able to fly a limited number to England directly from Stockholm. Due to limitations in crossing the battle areas, the majority of Norwegian volunteers had to travel a long circuitous route to England.²⁶ For example, two of the GROUSE team members traveled from Norway to England through Bombay.²⁷

Spulak recognizes “self-selection” as a possible way to select personnel with SOF attributes and suggests that “part of selection of attributes is *self-selection* in who is motivated to volunteer for SOF and who is motivated to stay.”²⁸ Norwegians that made the troublesome journey to England in order to volunteer for fighting the German occupation force must have had a strong motivation for their cause. Travel to England was not a formal part of the selection, but it was a means of efficient *self-selection*.

In the formal selection in England, SOE initially recruited personnel to its operations branch by interview. Norwegians who had distinguished themselves in the resistance against the German invasion or occupation, or had done so otherwise were approached by recruitment officers. Second, soldiers were selected during training. To

become a part of the operations branch of SOE, soldiers had to pass four stages of training.²⁹ At all stages, the soldiers could be considered disqualified from further progression. Altogether the selection and training program ensured that the operations branch consisted of SOF personnel of high military standards.

Overcoming friction

SOE managed to select and train teams with the right qualities to overcome the extreme friction presented by weather, terrain, and the enemy in the Rjukan area. When the environment of Vemork is considered, overcoming friction was a most challenging task for the SOE team. In January 1943 the German guard force at Vemork numbered thirty soldiers. After discovering Operation FRESHMAN, the Germans reinforced the defense of the plant with a minefield.³⁰ Furthermore, weather and snow conditions during winter, combined with steep terrain, left the Germans to believe that the road through Rjukan was the only likely avenue of approach to the heavy water plant. In Rjukan, the German forces numbered 200³¹ and the Germans also controlled a network of sympathizers among the local Norwegian population.

Jens Anton Poulsson, leader of Operation GROUSE, still believed that the conventional Operation FRESHMAN could have succeeded if only one of the two gliders had been able to land on the prepared landing site.³² Nonetheless, both the plans and the outcome for Operation FRESHMAN show how much the operation was limited by the frictions of the operating environment. The engineers lacked winter warfare skills, which made the plan marginally feasible and left no room for contingency plans.

SOE's initial objections to the plans for Operation FRESHMAN demonstrate that the newly established SOF community already understood the importance of mastering

the operating environment. All SOE objections were based on the impact of terrain and weather on the operation;³³ moreover, the conventional soldiers of the 1st Airborne Division had few contingency options if their primary plan failed. First, glider insertion limited flexibility once the group was over Norway. A return to England was possible in theory but fuel limitations and increased vulnerability from German anti-aircraft guns meant that the tow planes most likely would have to release the gliders once over Norway. Thus, the gliders crossed the practical point of no return before entering Norway,³⁴ leaving Operation FRESHMAN without the flexibility of Operations GUNNERSIDE and GROUSE. For the SOE parachutists, the decision point was the jump, which meant that they had the option to abort the mission at any stage during the flight, in case of last minute changes in the situation. Indeed, in January 1943 the team had to abort an insertion attempt over the drop zone because of deteriorating weather conditions.³⁵

Second, the lack of winter warfare expertise in general and skiing skills in particular, left Operation FRESHMAN with limited flexibility to adjust the plan if the landing had been successful. Lack of winter warfare and survival skills meant that the British engineers may not have been able to extract even in the case of a successful strike. According to Poulsson, "GROUSE men always considered it likely that the FRESHMAN personnel were on a one-way ticket. They would never have managed to get across to Sweden."³⁶ Moreover, 1st Airborne Division's engineer's limited ability to master the winter conditions led to the decision that if a soldier could not keep up with the unit, his fellow soldiers should give him morphine and leave him behind.³⁷ Altogether, Operation FRESHMAN was a bold venture that had a narrow chance of success. Combined

Operations Command's decision of launching two teams of engineers for the mission was a means for increasing the likelihood of a successful outcome, since a single team was deemed sufficient for the task. This decision was also telling of the views of two different communities; the British conventional forces priority on mass versus SOE's full priority on quality.

In stark contrast to FRESHMAN's limitations in the operating environment of winter Norway, stands GROUSE's ability to adapt to changing plans, roles, and timelines during their four months of efforts in the same winter conditions. Both GUNNERSIDE and GROUSE personnel were selected from the operations branch of SOE by their team leaders Ronneberg and Poulsson. These two officers had been functioning as instructors within SOE and had thorough knowledge of the Norwegian personnel. In addition to demolition skills, Ronneberg lists ski skills and cooperative skills as the most important criteria for selecting the members of the two teams, adding that "he had personal knowledge of each member and knew what they were good for."³⁸ Both SOE's appointment of skilled team leaders and these leaders' selection of team members were focused on finding the men that were best suited for the specific mission at Vemork. Thus, SOE's personnel assigned to the operations were experts on the operating environment that was so unfamiliar to the FRESHMAN personnel.

The terrain and weather were the main sources of friction in the Vemork raid and the flexibility SOE gained by selecting soldiers that were highly trained for the operating environment proved to be of utmost importance for the operation. The priority SOE put on finding the right men for the environment at Vemork complies with Spulak's theory on SOF success by addressing the ultimate sources of friction and selecting appropriate

attributes to overcome those sources. SOE's priority on winter warfare experts shows that they assessed the critical phase of the operation different from Combined Operations Command. Whereas Combined Operations Command prioritized actions on the objective by forming Operation FRESHMAN of combat engineers, SOE prioritized the task of getting to the objective, Spulak's *certain access*. In hindsight, SOE clearly understood the military challenge at Vemork best. The operation called foremost for winter warfare experts, while the specific skill, the demolition on the objective, proved to be of secondary importance. Even though the SOE members had fairly skilled demolition experts in the team, they were not engineers. However, the specific demolition of the heavy water apparatus could be exercised during preparations for the operation, and the technicalities of the demolition itself did not turn out to be a source of friction for the operation.

Operations GROUSE and GUNNERSIDE's ability to address the ultimate source of friction, the operating environment, provided the operation with the element of surprise and enabled the small force to avoid German guards on the objective as well as German troops in general in the surrounding areas. The group negotiated terrain during the bold infiltration to and exfiltration from the target area that was so steep that the German guards at Vemork had deemed the terrain impassable.³⁹ Furthermore, the operation adhered to McRaven's principle of speed. German forces were rendered ineffective as they discovered the operation only after the demolition was completed and the GUNNERSIDE team was withdrawing.

In addition to the wise choice of selecting winter-skilled Norwegians - predominantly locals from the Rjukan area - to carry out Operations GUNNERSIDE and

GROUSE, SOE's training program also proved important for the success of the mission. *Kompani Linge's* general training took place in Scotland, "where the terrain most closely approximated to the wilds of their homeland and offered the only place in Britain where they could practice cross-country skiing for significant periods of the year."⁴⁰

Furthermore, the general training was focused on small unit operations, where self-sustainment was central. The teams trained for carrying all their own supplies, and all skill-sets needed for the missions, including special demolitions, medical expertise, and communications, had to be covered by the members of the team. In order to be ready for covert insertion, SOE put all personnel through parachute training. In sum, the personnel from *Kompani Linge* were highly specialized for their task; small unit operations in their homeland, Norway. By focusing on environmental skills and self sustainment, SOE provided training that produced Spulak's "elite warriors" for the Norwegian operating environment. These self sustained teams of winter warfare experts were well prepared to overcome frictions to the operations.

Together with the winter skills, command relations supported Operation GROUSE's ability to operate independently, when mission-critical communications with SOE broke down. The communications equipment was key for Operation GROUSE, both for coordination of the preplanned mission, and especially for receiving new plans and orders after Operation FRESHMAN failed. Operation GROUSE had an experienced telegraph operator - according to SOE the best they had in the unit during World War II⁴¹ - but the communications set had limitations, resulting in long periods without guidance from SOE, while the team struggled to get communications running. Team leader Poulsson's ability to lead GROUSE through these uncertainties showed his qualities as a

leader and his thorough understanding of the mission's intent, but it also proved the importance of GROUSE's winter expertise. The ability to fully master the operating environment provided the team with enough time to reestablish the mission-critical communications with SOE.

Motivation

McRaven lists a strong sense of purpose, or motivation, as one of the main factors needed for a special operation to succeed. Based on this motivation, "the moral factors of courage, intellect, boldness, and perseverance have to ... prevent the frictions of war from ... causing defeat."⁴² Operation GUNNERSIDE was a bold venture where the participants knew the high risks involved in the face of numerous German soldiers. Even though the courage of the conventional soldiers volunteering for the risky Operation FRESHMAN was admirable, Operations GUNNERSIDE and GROUSE tested courage and perseverance of the Norwegian soldiers to extremes. A strong motivation was the foundation that helped the members of these SOE operations overcome the hardships they faced at Vemork.

The Norwegian members of SOE had already been through several situations testing their motivation. The only reason they fled to neutral Sweden after organized resistance in Norway ended was to proceed to England and to have the chance to continue the fight from there. Furthermore, they had all passed the hardships of training and selection needed to become a member of the operations branch of SOE, but Vemork was the ultimate challenge that exemplified the importance of motivation for participants in a special operation.

The members of GROUSE did not fully understand the use or importance of the heavy water at that time, but they understood the end state of the mission and were very determined to achieve it. This motivation was tested to the extremes and proven during Operation GROUSE's four month long reconnaissance mission. The conditions Operation GROUSE faced were so harsh that the team members had physical signs of undernourishment when they linked up with Operation GUNNERSIDE. Discolored skin from vitamin deficiency added to their skinny, ghostlike appearances at this stage. The group had pushed their physical limits so far during Operation GROUSE that after the operation, one of the members was diagnosed with beri-beri, a serious illness resulting from malnutrition.⁴³ In these conditions, and after the failure of Operation FRESHMAN had rendered original orders for Operation GROUSE obsolete, no one could have blamed the team if they had aborted the mission and left the extreme winter conditions.⁴⁴ Instead, the team was relieved to receive the message from SOE to stay put for a new operation.⁴⁵

Operations like FRESHMAN that gathered volunteers regardless of the limited knowledge the soldiers had of the risks involved displays courage based on a strong motivation to fight Hitler's forces. Such courage is seen throughout many Allied operations in World War II; however, Operation GROUSE remains special. The members displayed a degree of perseverance that few other operations can match, demonstrating a distinction in the type of motivation needed for special operations and conventional operations. Since SOF normally operates in small, self-sustained groups that are highly dependent on all its members, every SOF member needs to possess a strong motivation for fulfilling the end state of the mission. Furthermore, the strategic

importance of SOF missions and the high risks involved call for highly dedicated personnel.

McRaven argues the importance of purpose for special operations whereas Spulak's theory further distinguishes between conventional and special operations in their motivation and risk. Spulak's statement that "special operations are missions to accomplish strategic objectives where the use of conventional forces would create unacceptable risks due to Clausewitzian friction,"⁴⁶ illustrates not only that SOF missions accept high risks but also that all SOF missions should be of high importance. Since SOF personnel are expected to face and mitigate high risks, the soldier's will play an important role. Consequently, SOF personnel's strong motivation is both a result of the importance of a special operation mission and an element that is needed in order to face high risks.

Although a strong motivation fosters courage to execute missions and fulfill the commander's intent, SOF should aim beyond commander's intent. Because of the high importance of special operations, failure may be fatal. Hence, SOF should mitigate the risk of failure by flexibility. In order to become the flexible force that can handle "informational uncertainties and unforeseeable differences between perceived and actual reality"⁴⁷ SOF must expect that even the commander's intent⁴⁸ might change during a mission. When calling for flexibility, Spulak writes that "we can't know what's out there."⁴⁹ The uncertainty of the battlefield means that creativity and flexibility are important means to handle major changes to the plan. For Operation GROUSE, creativity and flexibility was the difference between mission failure and success. The members' motivation for achieving the end state was stronger than merely a spark for igniting

courage; it was a lasting quality that gave them endurance to push themselves to limits of physical damage, even when all initial plans appeared obsolete.

The benefit of Operation GROUSE's flexibility and will to carry on with their mission was that it gave SOE time to plan for a new mission after Operation FRESHMAN's failure. In an interview on 10 June 2009, the team leader explained how he was able to withstand the physical and mental strains during four months of reconnaissance prior to the raid on the objective, stating that "my motivation was love for King and country."⁵⁰ Colonel Poulsson's answer shows how determined he was in destroying the heavy water production. Motivation to withstand the challenges Operation GROUSE faced during their four month stay in the harsh winter of 1942 to 1943 goes beyond military professionalism. It was also an extreme motivation for achieving the end state of the mission.

Preparations

Preparations for Operations GUNNERSIDE and GROUSE were thorough not only for specifics of the operations like the demolition but also with regards to more general matters like winter equipment. Specific preparations towards the Vemork objective were "indispensable in eliminating the barriers to success," as emphasized by McRaven. Furthermore, general preparations enabled the operations to maintain their flexibility, one of the three key SOF qualities of Spulak's theory. The key elements of the preparation for the strike at Vemork were the reconnaissance mission and Operation GUNNERSIDE's rehearsals.

Looking at the work put into preparation before the strike at Vemork, it is evident that SOE understood the utmost importance of detailed rehearsals for a special operation.

Preparations followed both McRaven's principle of repetition and Spulak's emphasis on flexibility made possible by discovering the "ground truth."⁵¹ In Operations GROUSE and GUNNERSIDE erroneous parachute drops challenged the plan from the moment the personnel landed but thorough preparations enabled the groups to carry on with their missions. This ability to plan for contingencies gave the SOF missions a flexibility that the conventional operation, Operation FRESHMAN, lacked.

Operation GROUSE's four month long reconnaissance mission ensured valid and timely information for the planning and execution of Operation GUNNERSIDE. The extensive reconnaissance period was a result of circumstances that could not have been foreseen: the tragic failure of Operation FRESHMAN and the several weather delays of Operation GUNNERSIDE. Consequently, most of the time at the mountain plateau was a matter of waiting and survival; nevertheless, the reconnaissance mission was vital for the strike at Vemork. In addition to providing information on the situation in the target area that supported Operation GUNNERSIDE's preparations in England, Operation GROUSE's contribution to the operation after link up was substantial. The team leader, Poulsson and his men harbored the GUNNERSIDE team into a safe cabin from where they would carry out the last coordination of the plans. The reconnaissance party's views were incorporated, and the operations team adjusted its infiltration and exfiltration plans accordingly. In a 2009 interview, Poulsson observed with characteristic understatement in his response to the question of whether the operation could have succeeded without the reconnaissance that "it would have been hard."⁵²

Operation GUNNERSIDE did not waste time while waiting for insertion. Rehearsals during their preparations in England were carried out on a "mock-up model of

the apparatus... which was an exact exterior copy of the real target.”⁵³ According to McRaven, a full dress rehearsal like the training Operation GUNNERSIDE went through is “essential to the success on the battlefield,”⁵⁴ and this proved to be true for Operation GUNNERSIDE. Furthermore, as McRaven states, “repetition, by its very nature, improves speed on the target.”⁵⁵ This speed was most likely the reason why the small group was able to place the charges and withdraw before the German guards could react.

SOE used a Norwegian scientist, Professor Leif Tronstad, who had detailed knowledge about Vemork and Germany’s use of heavy water, as an advisor during the training for Operation GUNNERSIDE.⁵⁶ The thorough training that Operation GUNNERSIDE undertook as a result of this knowledge about the objective is in accordance with the well known quality of precision in special operations.⁵⁷ The knowledge enabled the small group to capitalize on precision in lieu of mass and infiltrate the important high concentration installation uncompromised.

The training on a full scale model also enabled the GUNNERSIDE team to place their charges only at the most critical and vulnerable structures of the heavy water production plant: a surgical pinprick with strategic effects. Moreover, the team’s detailed preparations were keys to success in the contingency planning that proved immediately necessary the moment they landed on Norwegian soil. After the erroneous parachute drop that added distance to the planned offset landing of Operation GUNNERSIDE, the members realized that they were not able to reach their objective with their heavy load of explosives. Based on Tronstad’s guidance and priorities during training, Operation GUNNERSIDE made the decision to carry only the explosives needed for demolishing the high concentration installation.⁵⁸ This adjusted plan proved to be sufficient to

neutralize the heavy water production, and, most likely, it saved the mission, considering the extra distance Operation GUNNERSIDE had to cover by skis.

In addition to the preparations that were enabled by the local knowledge, the reconnaissance mission, and the rehearsals; detailed preparations of equipment also proved to be important for the mission. U.S. doctrine for special operations (Joint Pub 3-05) identifies “specially equipped” as a part of the definition of SOF.⁵⁹ This is often misinterpreted as a matter of high technology, but in practice the important issue is to have optimized equipment. SOE understood the need for optimizing GUNNERSIDE and GROUSE for the environment; consequently, both team leaders procured and designed their own special equipment. Based on their winter skills, the two team leaders requested clothing, skis, and rations that were not standard issue. The team leaders’ efforts in these minor, but important, improvements demonstrated both the thoroughness of their preparations, and their respect for the winter conditions in the area of Vemork. Especially for Operation GROUSE, the optimized equipment proved important for their prolonged stay on the mountain plateau. Altogether, these preparations enabled the two patrols not only to carry out an audacious plan, but also to remain flexible and implement successful changes at all stages where friction challenged the original plan.

Conclusion

When the Allies assessed possibilities for destroying the German controlled heavy water production at Vemork in late 1942, the strong terrain and harsh winter conditions were the main challenges for a military operation. The British Combined Operations Command found itself limited in courses of action for the operation and the first attempt, the glider insertion of Operation FRESHMAN, resulted in the death of 41 British

soldiers. This conventional operation had limited flexibility, lacked contingencies, and failed in the rough weather and terrain of Norway.

After the failure of Operation FRESHMAN, the two small teams for Operations GUNNERSIDE and GROUSE experienced success when they destroyed the heavy water production and escaped without either firing a single shot or causing collateral damage. The important key to success for Operations GROUSE and GUNNERSIDE was the missions' special operations nature. The SOF personnel had skills that enabled them to remain flexible when faced with the friction of weather, terrain, and changing plans. The ability to adapt to these frictions helped them overcome major challenges to their plans and was vital for the success at Vemork.

As another example of the effectiveness of special operations over more conventional approaches, it is important to consider subsequent operations at Vemork. German efforts to reconstruct the heavy water plant in the nine months following Operation GUNNERSIDE led the Allies to launch a new conventional operation: the bombing of Vemork in November 1943. The result of the bombing proved true the challenges of the operating environment at Vemork as the underground heavy water installations remained intact. Additionally, the bombing resulted in collateral damage, including twenty Norwegian civilians killed at Rjukan.⁶⁰ Again, SOE had more success in a following mission carried out by SOF personnel. The sinking of a Norwegian ferry carrying heavy water caused civilian casualties but achieved the objective of denying Hitler this strategic resource.

Patrol sized operations achieved a strategic outcome with their efforts in February 1943, with a precise hit on the most vulnerable point of the heavy water production that

SOE accomplished without losing personnel and without causing collateral damage. The small group of selected SOE soldiers capitalized on their specialized training, skills, and their unique motivation, when carrying out their mission in an extremely difficult operating environment. The planning and execution of Operations GUNNERSIDE and GROUSE were textbook SOF operations that illustrate today's theories of special operations. Like SOE during World War II, today's SOF units should carefully select, train, and employ only the limited number of soldiers that are able to fully master the operating environment. By mastering the operating environment and embracing the sources of friction rather than accepting their restrictions, SOF units can contribute to the current fight as flexible and creative elite warriors.

Notes

¹ Heavy water contains a higher proportion than normal water of the isotope deuterium. German scientists needed heavy water in large quantities as they used it as braking fluid in the chain reaction within the nuclear reactor. Jens-Anton Poulsson, *The Heavy Water Raid: The Race for the Atom Bomb 1942-1944* (Orion Forlag AS, 2009), 89.

² SOE report, *S.O.E. and "Heavy Water"*, London, April 1944, 1.

³ Robert G Spulak, Jr; *A Theory of Special Operations*, JSOU report 07-7 (The JSOU Press, Hurlburt Field, Florida), 21.

⁴ William H McRaven, *SPEC OPS; Case Studies in Special Operations Warfare: Theory and Practice* (Presidio Press, 1996), 11.

⁵ McRaven, 11.

⁶ McRaven, 11.

⁷ Spulak, 21

⁸ Carl Von Clausewitz, *On War* (Everyman's Library, 1993), 140.

⁹ Clausewitz, 138.

¹⁰ Spulak, 21.

¹¹ Spulak, 23.

¹² Thomas Gallagher, *Assault in Norway. Sabotaging the Nazi Nuclear Program* (The Lyons Press, 2002), 17.

¹³ Ray Mears. *The Real Heroes of Telemark* (Hodder and Stoughton, 2003), 21.

According to the author Ray Mears, the six different courses of action were: "1) Using men already employed at Vemork to blow up the stocks; 2) deploying agents to infiltrate the plant; 3) sending in an SOE sabotage party; 4) a Combined Operations attack using hydroplanes for arrival and departure; 5) sending in...a 'suicide squad', i.e. one that had no chance of escaping afterwards; 6) RAF bombing."

¹⁴ Gallagher, 20: The Norwegian scientist who served as an advisor for SOE pointed out that Rjukan, the electrical-power center of southern Norway, had large liquid-ammonia (liquid-ammonia is a flammable gas that is stored under high pressure) storage tanks.

¹⁵ Haukelid, 50.

¹⁶ Poulsson, 107.

¹⁷ SOE renamed Operation GROUSE in the new plans, but the members of the reconnaissance party never used the new name, Operation SWALLOW.

¹⁸ Haukelid, 6. (Introduction by General Major Sir Collin Gubbins, CO of Special Operation Executive.)

¹⁹ Haukelid, 78-79. Team Gunnerside waited three months for the right conditions for an insertion. In January 1943 the team came close, but had to abort an attempt when they were over the drop zone.

²⁰ Some sources (e.g. Haukelid, 74) include *Einar Skinnarland* and count 11 members in the heavy water raid. Skinnarland was a SOE member and parachuted into Rjukan 6 months prior to Operation GROUSE. He worked as a covert agent and was deeply involved in the heavy water raid, but not a part of either GUNNERSIDE nor GROUSE.

²¹ Joachim Ronneberg, *Operation "Gunnerside." Fenrik Ronneberg's Report*. London, April 1943, 15. Half of the group had received follow-on missions in Norway and did not exfiltrate to Sweden.

²² Ray Mears. *The Real Heroes of Telemark* (Hodder and Stoughton, 2003), 22.

²³ Knut Haukelid. *Skis Against the Atom* (North American Heritage Press, 1989), 2. (Introduction by General Major Sir Collin Gubbins, CO of Special Operation Executive.)

²⁴ Spulak, p 1. "Special Operations Forces (SOF) are small, specially organized units manned by carefully selected people using modified equipment and trained in unconventional applications of tactics against strategic and operational objectives."

²⁵ Mears, 31.

²⁶ Poulsson, 90. Poulsson explains how his team member Haugland was given priority on the flight from Sweden because of his skill as a telegraph operator. Sverre Steen, *Norges krig 1940-1945* (Gyldendal Norsk Forlag, 1947), 663 describes the flight *Stockholmsruten* from Sweden to England, and its limitations.

²⁷ Poulsson, 48.

²⁸ Spulak, 12

²⁹ Tomas Adam, email message to author, January 10, 2010. The four stages of training were: stage 1) basic training; stage 2) sabotage operations; stage 3) parachute training; 4) mission specific training.

³⁰ Haukelid, 71.

³¹ Jostein Berglyd, *Operation Freshman, The Hunt for Hitlers Heavy Water*, (Stockholm: Leandoer & Ekholm Forlag, 2006), 26.

³² Jens-Anton Poulsson, interview with author, June 10, 2009.

³³ Gallagher, 18: "When Combined Operations turned to SOE for advice, the Norwegian Section objected to the plan on the grounds that it was ill-conceived and susceptible to too many failures at too many stages in its operation." Gallagher continues with a list of nine points pointed out by Wilson and Tronstad of SOE. All nine points are possible points of friction to the operation due to terrain or weather.

³⁴ Berglyd, 34: "Lieutenant Colonel Mark Henniker...led the training and planned the operation... He argued that the distance from the central base of the operations... to the landing site in Hardangervidda was too long."

³⁵ Haukelid, 79.

³⁶ Poulsson, 108.

³⁷ Berglyd, 30.

³⁸ Ronneberg, interview with Tomas Adam, January 10, 2010.

³⁹ Haukelid, 100.

⁴⁰ Mears, 34.

⁴¹ John Berg, *Soldaten som ikke ville gi seg: Lingekaren Arne Kjelstrup 1940-45*, (Metope, 1986), 102.

⁴² McRaven, 11.

⁴³ Berg, 146.

⁴⁴ In a 10 June 2009 interview with author, the GROUSE team leader stated that in the conditions Operation GROUSE faced, no one could have second-guessed a decision to abort the mission.

⁴⁵ Poulsson, 104.

⁴⁶ Spulak, 1.

⁴⁷ Spulak, 20.

⁴⁸ Headquarters U.S. Marine Corps, *Marine Corps Planning Process*, MCWP 5-1, (Washington, DC: U.S. Marine Corps, January 5, 2000), 2-3 and G-96: commander's

intent includes purpose, method, and endstate of enemy and own forces (location and status).

⁴⁹ Spulak, 20

⁵⁰ Poulsson, interview with author, June 10, 2009.

⁵¹ Spulak, 20.

⁵² Poulsson, interview with author, June 10, 2009.

⁵³ Poulsson, 133.

⁵⁴ McRaven, 16.

⁵⁵ McRaven, 10.

⁵⁶ Haukelid, 71.

⁵⁷ Lieutenant-Colonel Jamie Hammond, "Special Operations Forces: Relevant, Ready and Precise," *Canadian Military Journal*, July 14, 2008,

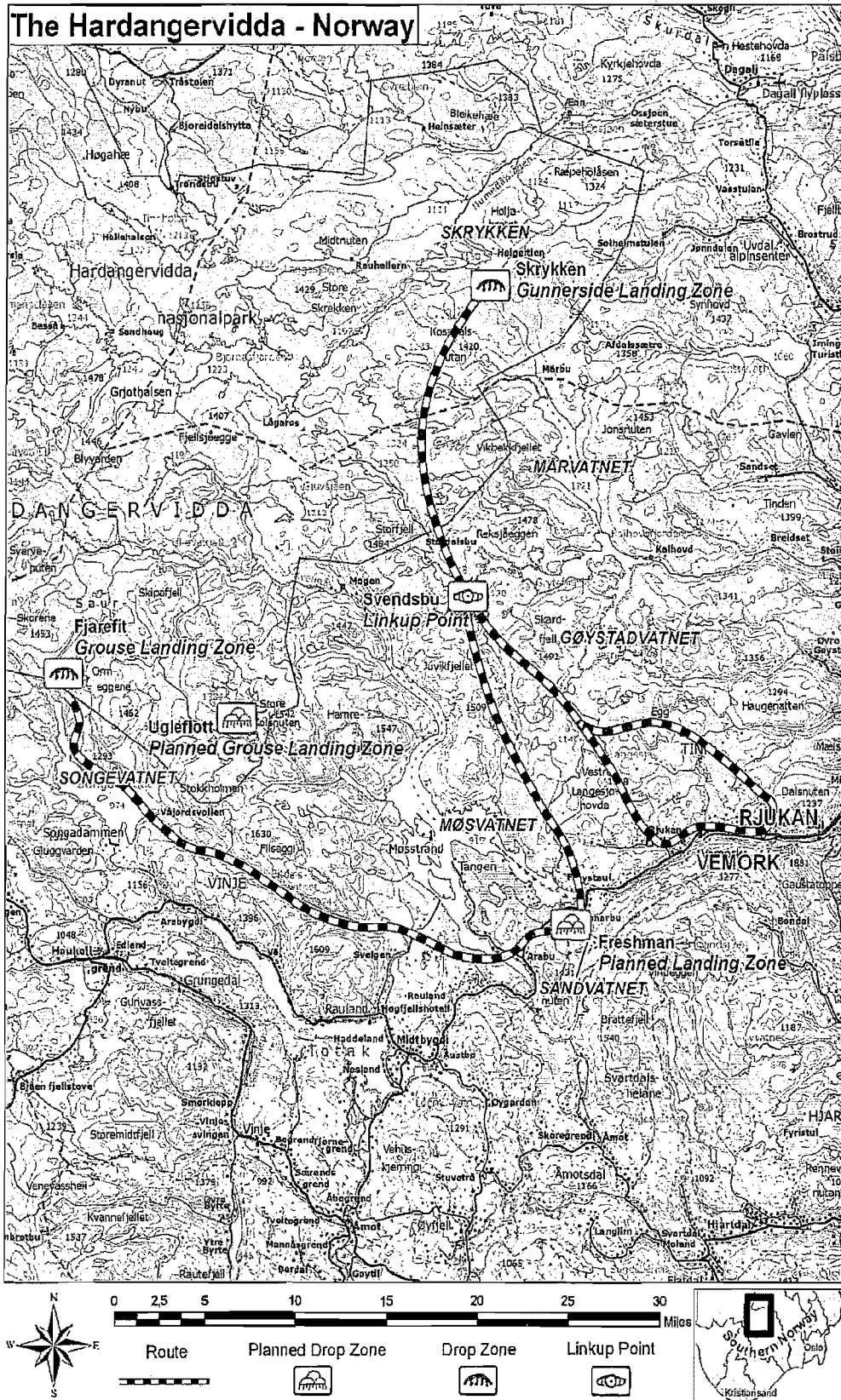
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⁵⁸ Haukelid, 86

⁵⁹ U.S. Department of Defense. *Doctrine for Joint Special Operations*, Joint Pub 3-05, April 17, 1998, GL 10.

⁶⁰ Poulsson, 168.

Map Operations Gunnerside, Grouse, and Freshman



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