

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NEW NGC, INC. dba NATIONAL GYPSUM COMPANY,
Petitioners

v.

UNITED STATES GYPSUM COMPANY,
Patent Owner

Case: IPR2017-01352

U.S. Patent No. 8,142,914

PETITIONER'S EXHIBIT NO. 1001
DECLARATION OF GERRY HARLOS

TABLE OF CONTENTS

I.	PROFESSIONAL BACKGROUND.....	1
II.	SCOPE OF THE ENGAGEMENT	4
III.	PERSON OF ORDINARY SKILL IN the ART	8
IV.	LEGAL UNDERSTANDINGS.....	8
A.	Claim Interpretation	8
B.	Prior Art.....	10
C.	Anticipation.....	11
D.	Obviousness	11
i.	Motivation to Combine	13
ii.	Secondary Considerations.....	15
E.	Date of Invention.....	17
V.	BACKGROUND OF TECHNOLOGY	17
i.	Enhancing Materials.....	23
VI.	THE '914 PATENT.....	33
A.	Introduction	33
B.	Prosecution History of the '914 Patent	40
C.	The Challenged Claims	42
D.	Priority Date	43
VII.	CLAIM INTERPRETATION OF THE '914 PATENT.....	44
i.	Enhancing Material	44
ii.	Accelerator	48
VIII.	GROUND 1: OBVIOUSNESS OF CLAIMS 1-4, 6, 8, AND 10 BASED ON GRAUX IN VIEW OF ASTM C473-95, HJELMELAND, SUCECH	

AND SUMMERFIELD	48
A. Graux	49
B. ASTM C473-95	51
C. Hjelmeland	52
D. Sucech	54
E. Summerfield	55
F. Motivation To Combine Graux, ASTM C473-95, and Hjelmeland, Sucech, and Summerfield.....	55
G. Element by Element Analysis	63
i. Claim 1a: A gypsum board comprising	63
ii. Claim 1b: a core of material sandwiched between cover sheets, wherein the core comprises an interlocking matrix of set gypsum,.....	64
iii. Claim 1c: the board has been prepared by a method comprising:.....	66
iv. Claim 1d: forming or depositing a mixture between the cover sheets, wherein the mixture comprises a calcined gypsum, water, an accelerator, and one or more enhancing materials selected from the group consisting of: sodium trimetaphosphate, tetrapotassium pyrophosphate, tetrasodium pyrophosphate, aluminum trimetaphosphate, sodium acid pyrophosphate, ammonium polyphosphate having 1000-3000 repeating phosphate units, and acids, salts, or the anionic portions thereof, and,.....	67
v. Claim 1e: maintaining the mixture under conditions sufficient for the calcined gypsum to form the interlocking matrix of set gypsum,	69
vi. Claim 1f: the enhancing material or materials having been included in the mixture in an amount such that the gypsum board has greater sag resistance than it would have if the enhancing material had not been included in the mixture, said board having a sag resistance as determined according to ASTM C473-95 of less than about 0.1 inch per two foot length of said board	70
vii. Claim 1g: the accelerator having been included in an amount such that the gypsum board has greater strength than it would have if the accelerator had	

not been included in the mixture.....	73
viii. Claim 2: The gypsum board of claim 1, wherein the concentration of the enhancing material in the mixture is from 0.004 to 2.0 percent by weight, based on the weight of the calcined gypsum.....	74
ix. Claim 3: The gypsum board of claim 1, wherein the calcined gypsum comprises one or more of: calcium sulfate anhydrite; calcium sulfate hemihydrate; or ions of calcium and sulfate.	78
x. Claim 4: The gypsum board of claim 1, wherein the enhancing material comprises one or more of the following salts, or the anionic portions thereof: sodium trimetaphosphate and ammonium polyphosphate having 1000-3000 repeating phosphate units	78
xi. Claim 6: The gypsum board of claim 1, wherein the mixture further comprises a pregelatinized starch.	79
xii. Claim 8: The gypsum board of claim 1, wherein: the core has voids uniformly distributed therein; and the mixture further comprises an aqueous foam. 80	
xiii. Claim 10: The gypsum board of claim 1, wherein the mixture further comprises a pregelatinized starch and an aqueous foam.	82
IX. GROUND 2: OBVIOUSNESS OF CLAIMS 1-4, 6, 8, AND 10 BASED ON SATTERTHWAITE IN VIEW OF HJELMELAND, ASTM C473-95, SUCECH AND SUMMERFIELD	84
A. Satterthwaite.....	85
B. ASTM C473-95.....	87
C. Hjelmeland	88
D. Sucech	90
E. Summerfield	90
F. Motivation to Combine Satterthwaite, ASTM C473-95, Hjelmeland, Sucech, and Summerfield.....	91
G. Element-by-Element Analysis	100

i. Claim 1a: A gypsum board comprising:	100
ii. Claim 1b: a core of material sandwiched between cover sheets, wherein the core comprises an interlocking matrix of set gypsum,.....	100
iii. Claim 1c: the board has been prepared by a method comprising:.....	102
iv. Claim 1d: forming or depositing a mixture between the cover sheets, wherein the mixture comprises a calcined gypsum, water, an accelerator, and one or more enhancing materials selected from the group consisting of: sodium trimetaphosphate, tetrapotassium pyrophosphate, tetrasodium pyrophosphate, aluminum trimetaphosphate, sodium acid pyrophosphate, ammonium polyphosphate having 1000-3000 repeating phosphate units, and acids, salts, or the anionic portions thereof, and,.....	102
v. Claim 1e: maintaining the mixture under conditions sufficient for the calcined gypsum to form the interlocking matrix of set gypsum,	108
vi. Claim 1f: the enhancing material or materials having been included in the mixture in an amount such that the gypsum board has greater sag resistance than it would have if the enhancing material had not been included in the mixture, said board having a sag resistance as determined according to ASTM C473-95 of less than about 0.1 inch per two foot length of said board	108
vii. Claim 1g: the accelerator having been included in an amount such that the gypsum board has greater strength than it would have if the accelerator had not been included in the mixture.....	112
viii. Claim 2: The gypsum board of claim 1, wherein the concentration of the enhancing material in the mixture is from 0.004 to 2.0 percent by weight, based on the weight of the calcined gypsum.....	113
ix. Claim 3: The gypsum board of claim 1, wherein the calcined gypsum comprises one or more of: calcium sulfate anhydrite; calcium sulfate hemihydrate; or ions of calcium and sulfate.	116
x. Claim 4: The gypsum board of claim 1, wherein the enhancing material comprises one or more of the following salts, or the anionic portions thereof: sodium trimetaphosphate and ammonium polyphosphate having 1000-3000 repeating phosphate units.....	118
xi. Claim 6: The gypsum board of claim 1, wherein the mixture further	

comprises a pregelatinized starch.	118
xii. Claim 8: The gypsum board of claim 1, wherein: the core has voids uniformly distributed therein; and the mixture further comprises an aqueous foam. 120	
xiii. Claim 10: The gypsum board of claim 1, wherein the mixture further comprises a pregelatinized starch and an aqueous foam.	121
X. SECONDARY CONSIDERATIONS	124
XI. CONCLUSION.....	125

I, Gerry Harlos, do hereby declare and say as follows:

1. I have been asked to provide testimony as to what one of ordinary skill in the art would have understood with respect to the patent at issue and various prior art. I provide this testimony below.

I. PROFESSIONAL BACKGROUND

2. I have personal knowledge of the facts contained in this Declaration, am of legal age, and am otherwise competent to testify.

3. I graduated from the University of Calgary in 1971 with an honors bachelors of science degree in physical, organic chemistry. I then began working at Western Research and Development, a technology supply company for the natural gas industry in western Canada, as a chemist. While at Western Research and Development, I developed portable primary standard calibration techniques for monitoring sub-parts-per-million levels of sulfur dioxide air and instrumental techniques for total sulfur analysis on bauxite and alumina catalysts.

4. In late 1973, I joined Dow Chemical Company as a chemist in a production laboratory supporting the manufacture of vinyl chloride monomer; 1,1,1 trichloroethane; carbon tetrachloride; perchloroethylene; and mono-, di-, and triethanolamine. I established the first laboratory information management system at Dow Chemical and was then appointed chlorinated products production lab manager in 1976 and continued to oversee the laboratory information system.

From 1978-1980, I was manager of process analyzer development, in which I oversaw the design and installation of automated analytical instrumentation within ten separate manufacturing facilities at one manufacturing location. In 1981, I transferred to a polystyrene manufacturing plant where I assisted to further computerize the control system and optimized the plant by improving design and efficiency, thus dramatically improving manufacturing yield. In this position, I also learned the ins-and-outs of statistical process control that then became a newly-practiced discipline across all manufacturing facilities.

5. In 1988, I moved from Dow Chemical to Domtar and assumed the role of manager of quality for the Gypsum Division, which required that I oversee quality assurance processes in 11 board plants and 2 paper mills across the division. In this role, I coordinated and unified manufacturing quality assurance by generating analytics and test methods for evaluating boards, I oversaw testing of raw materials, and I generally managed the quality assurance of the boards produced at the plants. Between 1988 and 1990, I helped to evolve and optimize the manufacturing processes of gypsum board in order to create lighter, sag-resistant boards. I also helped to implement new technologies used to test and manufacture these boards. During this time, I designed and oversaw the assessment of ceiling sag resistance performance for all North American gypsum board producers and then implemented a rigorous quality assurance structure to

ensure that all new Domtar CD Ceiling® board would meet a much-enhanced company-internal performance standard with respect to humidified deflection when tested according to ASTM C473. From 1992 to 1996, I continued to optimize the manufacturing plants in a multi-disciplinary team setting with emphasis on understanding why certain manufacturing facilities achieved better results than others in specific areas of internal conversion processes, sometimes with virtually identical hardware. I was directly involved with formulation metering design improvements, trials of different retarders, accelerators, papers, boric acid, grinding aids, changes in stucco grinding to optimize particle size distribution, testing of new technology for particle size measurement, evaluation and optimization of the use of synthetic gypsum, and evaluation of pretreatment of stucco to reduce water demand. During this five-year period, I experimented with dense-layer stucco technology using roll coating systems for face and back papers to the improve paper-to-core bond while significantly reducing board weights. This work necessarily involved extensive experimentation with independent control of the fluidity, slump, stiffening, and final set of three independent slurry streams making up the board core.

6. In 1996, I left Domtar and began my own consulting firm in the gypsum field, offering technical support to gypsum board manufacturers and to the specialized mills supplying gypsum paper. My services include, but are not

limited to, calcine optimization, stucco storage humidity management, additive metering design and optimization, mixer internal assessment, formulation optimization, dryer re-balancing, board weight reduction programs, plant design, start-up commissioning, paper optimization, analytical training for production support, laboratory design, and technical data system design.

7. My qualifications and publications are set forth more fully in my curriculum vitae attached as Exhibit A.

II. SCOPE OF THE ENGAGEMENT

8. I have been retained by Alston & Bird LLP on behalf of New NGC, Inc. dba National Gypsum Company (“Petitioner”) to provide analysis and opinions in connection with U.S. Patent No. 8,142,914 (“the ’914 patent”). I have also been asked to evaluate whether one of ordinary skill in the art would, at the time of the invention, have considered certain technologies and prior art to be relevant or material to determining the validity of the claims at issue.

9. My opinions are based on my experience and knowledge and the information I have reviewed as of the date of this report. In connection with my analysis, I have reviewed:

NGC914-1001 Expert Declaration of Gerry Harlos

NGC914-1002 U.S. Patent No. 6,632,550 (“the ’550 patent”)

NGC914-1003	U.S. Patent No. 6,342,284 (“the ’284 patent”)
NGC914-1004	Selections from the Prosecution History of the ’284 Patent
NGC914-1005	Selections from the Prosecution History of the ’550 Patent
NGC914-1006	U.S. Patent No. 5,932,001 (“Graux”)
NGC914-1007	U.S. Patent No. 3,234,037 (“Satterthwaite”)
NGC914-1008	U.S. Patent No. 5,980,628 (“Hjelmeland”)
NGC914-1009	ASTM C473-95
NGC914-1010	U.S. Patent No. 2,884,413 (“Kerr”)
NGC914-1011	U.S. Patent No. 3,770,468 (“Knauf”)
NGC914-1012	Thomas Koslowski & Udo Ludwig, <i>The Chemistry and Technology of Gypsum</i> , ASTM STP 861, 103 (R. A. Kuntze, ed., 1984)
NGC914-1013	Lydia M. Luckevick & Richard A. Kuntze, <i>The Relationship Between Water Demand and Particle Size Distribution of Stucco</i> , in <i>The Chemistry and Technology of Gypsum</i> , ASTM STP 861, 84-85 (R.A. Kuntze, ed., 1984)
NGC914-1014	ASTM C472-93
NGC914-1015	Robert F. Acker, Physical Testing of Gypsum Board Per ASTM C 473, 3-7 (R.A. Kuntze, ed., 1984)

NGC914-1016	L. Amathieu, <i>Improvement of Mechanical Properties of Set Plasters</i> , 79 J. of Crystal Growth 169, 176 (1986)
NGC914-1017	U.S. Patent No. 2,985,219
NGC914-1018	U.S. Patent No. 3,179,529
NGC914-1019	U.S. Patent No. 2,090,625
NGC914-1020	U.S. Patent No. 3,190,787
NGC914-1021	U.S. Patent No. 2,346,999
NGC914-1022	U.S. Patent No. 3,573,947
NGC914-1023	U.S. Patent No. 4,009,062
NGC914-1024	U.S. Patent No. 5,320,677
NGC914-1025	U.S. Patent No. 5,534,059
NGC914-1026	U.S. Patent No. 5,395,438
NGC914-1027	U.S. Patent No. 3,246,063
NGC914-1028	Redacted Complaint
NGC914-1029	[RESERVED]

NGC914-1030	[RESERVED]
NGC914-1031	ASTM C473-81
NGC914-1032	U.S. Patent No. 5,085,929
NGC914-1033	[RESERVED]
NGC914-1034	[RESERVED]
NGC914-1035	[RESERVED]
NGC914-1036	U.S. Patent No. 5,643,510
NGC914-1037	[RESERVED]
NGC914-1038	U.S. Patent No. 8,142,914
NGC914-1039	[RESERVED]

10. I am being compensated for my time spent on the present matter at a rate of \$775 per day and \$80 per hour. My compensation is not in any way contingent on my performance, the result of this proceeding, or any of the issues involved therein. I am also being reimbursed for expenses incurred as a result of activities performed as an expert.

III. PERSON OF ORDINARY SKILL IN THE ART

11. All of the opinions I express in this Declaration have been made from the standpoint of a person of ordinary skill in the field of the '914 patent at the time of the invention.

12. I consider that a person having ordinary skill in the art ("PHOSITA") at the time of invention would have had a bachelor's degree in chemical engineering or organic or physical chemistry and 3 to 5 years of experience in gypsum board manufacturing or a master's degree in chemical engineering or organic or physical chemistry and 2 to 3 years of experience. Additional education might substitute for some of the experience, and substantial experience might substitute for some of the educational background. As discussed in Section I, I myself met those qualifications at the time of the earliest priority date of the patent at issue, and I also supervised, worked with, and assisted people with those capabilities during the course of my career in this industry.

IV. LEGAL UNDERSTANDINGS

A. Claim Interpretation

13. I am not a Patent Attorney and I do not opine in this paper on any particular methodology for interpreting patent claims. My opinions are limited to what I believe a person of ordinary skill in the art would have understood the meaning of certain claim terms to be based on the patent documents. I use the principles below, however, as a guide in formulating my opinions.

14. I understand that it is a basic principle of patent law that assessing the validity of a patent claim involves a two-step analysis. In the first step, the claim language must be properly construed to determine its scope and meaning. In the second step, the claim as properly construed, must be compared to the alleged prior art to determine whether the claim is valid.

15. I understand that the words of a patent claim have their plain and ordinary meaning for a person skilled in the art at the time of the invention. This meaning must be ascertained from a reading of the patent documents, paying special attention to the language of the claims, the written specifications, and the prosecution history. I understand that an inventor may attribute special meanings to some terms by defining those terms or by otherwise incorporating such meanings in these documents.

16. My methodology for determining the meaning of claim phrases was first to carefully study the patent. In particular, I studied the claims themselves, followed by a study of the background, detailed specification, figures, and other patent content. Next, I reviewed the file histories looking for any clarifications or limitations that might be attached to claim terms. In some circumstances, I looked at other documents, such as references applied by the patent office.

17. I understand that in an *inter partes* review, claim terms of an expired patent are given claim terms are their ordinary and customary meanings, as would

be understood by a person having ordinary skill in the art, at the time of the invention, having taken into consideration the language of the claims, the specification, and the prosecution history of record. I understand that one must be careful not to read a specific embodiment appearing in the written description into the claim if the claim language is broader than the embodiment. I further understand that any special definition for a claim term must be set forth with reasonable clarity, deliberateness, and precision. Because I understand that the '914 patent will be expired after institution, I have considered each of the claim terms using this standard.

18. I understand that certain claim terms may be written as means-plus-function claim terms. I understand that for means-plus-function terms, the structure performing the claimed function is limited to the corresponding structure described in the specification and equivalents thereof.

B. Prior Art

19. It is my understanding that only information which satisfies one of the categories of prior art set forth in 35 U.S.C. § 102 may be used in any invalidity analysis under §§ 102 or 103. Therefore, if information is not properly classified as prior art under one of the subsections of § 102 of the Patent Code, then it may not be considered in an anticipation or obviousness determination. It is also my

understanding that, for *inter partes* review, applicable prior art is limited to patents and printed publications.

C. Anticipation

20. I understand that to anticipate a patent claim under 35 U.S.C. § 102, a single asserted prior art reference must disclose each and every element of the claimed invention, either explicitly or inherently, to a person of ordinary skill in the art. I understand that a disclosure of an asserted prior art reference can be “inherent” if the missing element is necessarily present or is the inevitable outcome of the process and/or thing that is explicitly described in the asserted prior art reference.

D. Obviousness

21. I am also informed and understand that a patent claim is invalid under 35 U.S.C. § 103 if the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious at the time of the invention to a person having ordinary skill in the art to which the subject matter pertains. Obviousness, as I understand, is based on the scope and content of the prior art, the differences between the prior art and the claim, the level of ordinary skill in the art, and secondary indications of non-obviousness to the extent they exist.

22. I understand that whether there are any relevant differences between the prior art and the claimed invention is to be analyzed from the view of a person of ordinary skill in the art at the time of the invention. A person of ordinary skill in the art is a hypothetical person who is presumed to be aware of all of the relevant art at the time of the invention. The person of ordinary skill is not an automaton, and may be able to fit together the teachings of multiple patents employing ordinary creativity and the common sense that familiar items may have obvious uses in another context or beyond their primary purposes.

23. In analyzing the relevance of the differences between the claimed invention and the prior art, I understand that I must consider the impact, if any, of such differences on the obviousness or non-obviousness of the invention as a whole, not merely some portion of it. The person of ordinary skill faced with a problem is able to apply his or her experience and ability to solve the problem and also look to any available prior art to help solve the problem.

24. An invention is obvious if a person of ordinary skill in the art, facing the wide range of needs created by developments in the field, would have seen an obvious benefit to the solutions tried by the applicant. When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, it would be obvious to a person of ordinary skill to try the known options. If a technique has been used to improve one device, and a person

of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique would have been obvious.

25. I understand that I do not need to look for precise teaching in the prior art directed to the subject matter of the claimed invention. I understand that I may take into account the inferences and creative steps that a person of ordinary skill in the art would have employed in reviewing the prior art at the time of the invention. For example, if the claimed invention combined elements known in the prior art and the combination yielded results that were predictable to a person of ordinary skill in the art at the time of the invention, then this evidence would make it more likely that the claim was obvious. On the other hand, if the combination of known elements yielded unexpected or unpredictable results, or if the prior art teaches away from combining the known elements, then this evidence would make it more likely that the claim that successfully combined those elements was not obvious. I understand that hindsight must not be used when comparing the prior art to the invention for obviousness.

i. Motivation to Combine

26. Obviousness may be shown by demonstrating that it would have been obvious to modify what is taught in a single piece of prior art to create the patented invention. Obviousness may also be shown by demonstrating that it would have been obvious to combine the teachings of more than one item of prior art. I

understand that a claimed invention may be obvious if some teaching suggestion or motivation exists that would have led a person of ordinary skill in the art to combine the invalidating references. I also understand that this suggestion or motivation may come from sources such as explicit statements in the prior art, or from the knowledge of a person having ordinary skill in the art. Alternatively, any need or problem known in the field at the time and addressed by the patent may provide a reason for combining elements of the prior art. I also understand that when there is a design need or market pressure, and there are a finite number of predictable solutions, a person of ordinary skill may be motivated to apply both his skill and common sense in trying to combine the known options in order to solve the problem.

27. In determining whether a piece of prior art could have been combined with other prior art or with other information within the knowledge of a person having ordinary skill in the art, the following are examples of approaches and rationales that may be considered:

- Combining prior art elements according to known methods to yield predictable results;
- Simple substitution of one known element for another to obtain predictable results;

- Use of a known technique to improve similar devices (methods, or products) in the same way;
- Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results;
- Applying a technique or approach that would have been “obvious to try” (choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success);
- Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to a person having ordinary skill in the art; or
- Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

ii. Secondary Considerations

28. As noted above, I understand that certain objective factors, sometimes known as “secondary considerations,” may also be taken into account in determining whether a claimed invention would have been obvious. In most instances, these secondary considerations of non-obviousness are raised by the patentee. In that context, the patentee argues an invention would not have been

obvious in view of these considerations, which include: (a) commercial success of a product due to the merits of the claimed invention; (b) a long-felt, but unsatisfied need for the invention; (c) failure of others to find the solution provided by the claimed invention; (d) deliberate copying of the invention by others; (e) unexpected results achieved by the invention; (f) praise of the invention by others skilled in the art; (g) lack of independent simultaneous invention within a comparatively short space of time; (h) teaching away from the invention in the prior art. I also understand that these objective indications are only relevant to obviousness if there is a connection, or nexus, between them and the invention covered by the patent claims.

29. I understand that certain “secondary considerations,” such as independent invention by others within a comparatively short space of time, indicates obviousness. I also understand that secondary considerations of non-obviousness are inadequate to overcome a strong showing on the primary considerations of obviousness. For example, where the inventions represented no more than the predictable use of prior art elements according to their established functions, the secondary considerations are inadequate to establish non-obviousness

E. Date of Invention

30. I understand that a prior invention requires a complete conception of the invention and a reduction to practice of that invention. The patentee has the burden of establishing a date of conception earlier than the filing date of the patent.

31. Conception is the formation in the mind of the inventor of a definite and permanent idea of the complete and operative invention. Conception must be proved by corroborating evidence which shows that the inventor disclosed to others his complete thought expressed in such clear terms as to enable those skilled in the art to make the claimed invention. The inventor must also show possession of every feature recited in the claims, and that every limitation was known to the inventor at the time of the alleged conception. Furthermore, the patentee must show that he or she has exercised reasonable diligence in later reducing the invention to practice, either actual or constructive. The filing of a patent application can serve as a constructive reduction to practice.

V. BACKGROUND OF TECHNOLOGY

32. Gypsum is a naturally occurring mineral in which, when found in nature in its “raw” or rock form, has the chemical name “calcium sulfate dihydrate” and the chemical formula $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$. Gypsum is commonly found in nature in evaporate beds associated with sedimentary rock formations as it is deposited from lake and sea water. Gypsum is the most common sulfate mineral

and has been used as a building material for centuries. Gypsum is mined domestically and abroad, and synthetic forms of gypsum having the same chemical name and chemical formula as naturally-occurring gypsum can also be created commercially as by-products of the scrubbing of sulfur oxides from the flue gas discharge of coal-fired power plants by virtue of the sulfur compound impurities contained within the coal. NGC914-1012, 103.

33. Gypsum-containing products, such as gypsum boards, plasters, and acoustical tiles, have been used in modern building applications for decades. Indeed, the '914 patent discloses U.S. Patent No. 2,985,219 to Summerfield ("Summerfield"), which is directed to manufacturing plasterboard from gypsum and was filed in December of 1958. NGC914-1017, 1:13-35; NGC914-1038, 9:19-27. Gypsum-containing products are often used as building materials in both construction and as a finish for walls and ceilings. A number of these products are described in the '914 patent. *See* NGC914-1038, 1:55-2:8.

34. When raw gypsum is heated, much of the water is driven out from the material, resulting in a different chemical form of gypsum called calcined gypsum or stucco. NGC914-1038, 2:9-22, 23:3-15. Calcined gypsum contains the hemihydrate form of gypsum and, when it is subsequently mixed with water, it results in calcium sulfate dihydrate, which was the original material used to create the calcined gypsum. NGC914-1038, 1:62-2:8, 23:1-45. The product that results

from hydrating calcined gypsum is often referred to as “set gypsum.” NGC914-1013, 84-85. The ’914 patent further states that “‘set gypsum’ and ‘hydrated gypsum’, are intended to mean calcium sulfate dihydrate.” NGC914-1038, 4:27-42.

35. The preparation for set gypsum-containing products was known in the art prior to the priority date of the challenged claims. This is described in the “Background” section of the ’914 patent that discloses:

Most such gypsum-containing products are prepared by forming a mixture of calcined gypsum (calcium sulfate hemihydrate and/or calcium sulfate anhydrite) and water (and other components, as appropriate), casting the mixture into a desired shaped mold or onto a surface, and allowing the mixture to harden to form set (i.e., rehydrated) gypsum by reaction of the calcined gypsum with the water to form a matrix of crystalline hydrated gypsum (calcium sulfate dihydrate). This is often followed by mild heating to drive off the remaining free (unreacted) water to yield a dry product.

NGC914-1038, 2:9-22. Accordingly, set gypsum-containing products are prepared simply by hydrating calcined gypsum and “other components.” It was also known that other ingredients were added to the calcined gypsum and water to improve the end product.

36. For example, starch is well known in the art as a critical ingredient in manufacturing set gypsum-containing products. Starch has been included in set

gypsum-containing products well before 1966. U.S. Patent No. 3,234,037 to Satterthwaite (“Satterthwaite”) “relates to the production of an improved starch binder composition” in set gypsum-containing products. NGC914-1007, 1:9-23. The below excerpt from Satterthwaite describes the importance of starch in set gypsum-containing products:

Starch and starch products have been used for many years as adhesives to bind together the various ingredients of the tile to form a plastic mass. The resulting plastic mass is then formed into a sheet, after which it is scored, dried in an oven, and processed for sale.

The starch products most commonly used as binders in the tile making process are the so-called thick-boiling starches, i.e. unmodified starches obtained directly from the wet milling process. These starches are inexpensive and have sufficient adhesive properties to be useful in the tile industry. Super-thick boiling starches have been made from the thick-boiling starches, for example, by chemical modification. Such products, when cooked, form heavier bodied pastes than those from untreated starches. *These super-thick boiling starches also have the ability to absorb and retain more water than unmodified starches. Because of these characteristics, when pastes of these products are mixed with the tile mass, they increase the wet tile strength and reduce the time required to dry the tile.*

NGC914-1007, 1:18-37 (emphasis added). As recognized in the background section of the ’914 patent, all that is required to manufacture a set gypsum-containing material is calcined gypsum and water. However, as disclosed in

Satterthwaite, persons of skill in the art were adding additional ingredients such as starch decades ago to increase the strength and reduce the drying time of the final product.

37. Starches are natural products and, as such, have natural variations. An important property of starch is its ability to absorb water. For use in set gypsum-containing products, starch with higher ability to absorb water is preferred because it provides certain beneficial properties including improved mix rheology, bubble structure, and dry strength. Pregelatinized starch undergoes a pretreatment process to modify certain properties of the starch. For example, the starch is heated and processed to increase the starch's ability to absorb water. In this regard, pregelatinized starch has a higher ability to absorb water than non-pregelatinized starch. Accordingly, one important difference between pregelatinized starch and non-pregelatinized starch is that, because pregelatinized starch has a higher ability to absorb water as a result of the pregelatinization process, in many cases, more non-pregelatinized starch must be used to achieve the same effect as a smaller amount of pregelatinized starch in set gypsum-containing products.

38. Binders have been a basic ingredient in set gypsum-containing products for decades. Indeed, U.S. Patent No. 3,179,529, filed in 1962, explains the utility of binders:

In order to enhance the strength of the bond between the gypsum stucco core and the paperboard liners, waste starches, corn flours, acid hydrolyzed starches and similar low cost starch containing binding materials have often been incorporated in the dry blend together with the stucco. . . During [drying], the above noted binder material migrates to the core face and appears to act as a protective barrier for the gypsum's water of crystallization, that is, these starch binders prevent the dehydration of the gypsum crystals which have bonded with the paperboard.

NGC914-1018, 1:33-50.

39. Persons of skill in the art first added starch to gypsum-containing products in order to help hold paper onto the gypsum core face of the gypsum-containing product. During manufacturing, the starch migrates to the gypsum-paper interface and serves to adhere the paper to the gypsum-containing core.

NGC914-1018, 1:33-50. However, at higher levels starch also acts as a co-binder that improves binding between gypsum crystals, enabling the manufacture of lighter gypsum-containing products. Crosslinking starch with additional enhancing materials, such as STMP, was well-known in the art to improve the co-binding properties of starch. In this regard, it was known to persons having skill in the art that starch crosslinked with STMP increases the strength of set gypsum-containing products.

i. Enhancing Materials

40. I note that I address the meaning of the term “enhancing materials” as used by the Patent Owner in the claims and the specification of the ’914 patent in Section VII below. In particular, in Section VII, it is my opinion that the definition of enhancing materials, at its narrowest, would include STMP in addition to other additives that improve at least one of resistance to permanent deformation, strength, and dimensional stability in set gypsum-containing products. I discuss here the relevant disclosures of the prior art showing the presence of one such “enhancing material” specifically identified in the ’914 patent, STMP. Thus, the discussion in this section does not depend on the meaning of the claim term “enhancing materials” adopted by the PTAB.

41. The specification of the ’914 patent describes enhancing materials as additives that improves one or more of the following attributes: strength, sag resistance, or maintenance of original dimensions (*i.e.* resistance to shrinkage).¹ The American Society for Testing and Materials (ASTM) has, for decades,

¹ I note that USG refers to this attribute as “dimensional stability” in the specification of the ’914 patent. Although I myself do not use this term, I understand the meaning as relevant to the field to the extent it is indicative of properties such as linear shrinkage or expansion. Thus, for the sake of clarity and simplicity, I will use USG’s terminology in this declaration.

provided specific standard tests used to measure these qualities in set gypsum-containing products. *See, e.g.*, NGC914-1014 & NGC914-1009. In 1975, the ASTM specifications for gypsum board were changed to “eliminate arbitrary weight limits and substitute performance tests” including “humidified sag resistance; core, end, and edge hardness; and nail pull resistance.” *See* NGC914-1015, 3-7.

42. The humidified deflection test is used to “evaluat[e] the deflection of gypsum board or gypsum lath when horizontally suspended and subjected to high humidity.” NGC914-1009, at ¶ 49. Additionally, the hardness test is used for “evaluating the relative ability of gypsum board or gypsum lath core, ends, and edges to resist crushing during handling or use of the material.” NGC914-1009, at ¶ 9. Further, the nail pull resistance test is used for “evaluating the ability of gypsum board or gypsum lath to resist nail pull-through by determining the load required to force a standard nailhead through the board or lath.” NGC914-1009, at ¶ 18.

43. The three attributes of strength, sag resistance, and dimensional stability, therefore, have long ago been quantified for purposes of maintaining and monitoring the quality of set gypsum-containing product. Accordingly, a person having ordinary skill in the art would have known that improvements to set gypsum-containing products are accomplished by maintaining or increasing

strength, sag resistance, and dimensional stability.

44. Indeed, the '914 patent states that "[t]he human eye typically cannot perceive sag of a gypsum-containing board at less than about 0.1 inch of sag per two foot length of board" and identifies "a need for gypsum-containing products that are resistant to permanent deformation over the useful life of such products." NGC914-1003, 2:39-41. However, as shown in FIGS. 2 and 3 of the '914 patent, set gypsum-containing products having sag of less than 0.1 inch were known in the art prior to the priority date of the '914 patent. For example, FIGS. 2 and 3 of the '914 patent illustrate the National Gypsum Company Gold Bond® High Strength Ceiling Board as having a sag resistance of .075 inches after 48 hours of testing, the same length of testing prescribed by ASTM C473-95. In this regard, the National Gypsum Company Gold Bond® High Strength Ceiling Board achieved improved sag resistance even better than the 0.1 inch requirement claimed by the '914 patent. Although the tests performed to provide the results illustrated in FIGS. 2 and 3 were not conducted in accordance with ASTM C473-95, it is my opinion that the tests used to produce the results illustrated in FIGS. 2 and 3 were conducted in harsher testing conditions that would cause more sag in the tested set gypsum-containing products due to the added weight from insulation and the potential for humidity to condense within the board core, as it does in real high humidity installations. NGC914-1038, 16:21-33. As such, set gypsum-containing

products having a sag resistance of less than 0.1 inch as claimed by the '914 patent were both known and commercially available prior to the priority date of the '914 patent.

45. Since the 1930s, “enhancing materials” have been known in the art. Indeed, U.S. Patent No. 2,090,625, which was filed in 1936, discloses treating gypsum with additives such as orthophosphoric acid, monosodium orthophosphate or sodium metaphosphate, and silica. NGC914-1019, 5:45-52. The resulting set gypsum-containing product showed increased strength when these additives were introduced into the manufacturing process. *See* NGC914-1019, 6:30-35, 6:65-75, 8:55-65. Moreover, as will be discussed below, Satterthwaite discloses the use of additives to improve set gypsum-containing products by “increas[ing] wet strength, increas[ing] density and increas[ing] resistance to warp or sag.” NGC914-1007, 1:60-63; *see below* at ¶¶ 136-138.

46. Additives improve the strength and increase the quality of set gypsum-containing products in part by changing the crystallization kinetics of gypsum. NGC914-1016, 176. Indeed, since at least the 1980s, it has been known that “additives give rise to a better arrangement of the crystals and to additional contacts or attractive forces between the crystals.” NGC914-1016, 176. Because set gypsum-containing products are used as building materials, that the products are high-quality has been and continues to be very important.

47. The list of materials disclosed in the '914 patent as being used to increase the quality of set gypsum-containing products includes boric acid, disclosing that boric acid significantly increases sag resistance and compressive strength of set gypsum-containing products. NGC914-1038, at Table 2. At least as early as 1963, boric acid was known to reduce sagging in set gypsum-containing products and is still used today for at least this purpose. NGC914-1020, 1:48-50. Natural gypsum is in some circumstances salt-infused due to its marine origins, but the salt causes the natural gypsum to sag. Boric acid reduces sag by ameliorating the effects of salt in the natural gypsum. *See* NGC914-1020, 1:48-50. However, adding too much boric acid can make set gypsum-containing products brittle. NGC914-1020, 1:52-64

48. Sodium trimetaphosphate ("STMP") is also a common additive in the manufacture of set gypsum-containing products that has been well-known in the art since 1961. Satterthwaite states that the starch used in the manufacture of set gypsum-containing products is often treated "with reagents such as epichlorohydrin, phosphorus oxychloride, cyanuric chloride, *sodium trimetaphosphate* and formaldehyde or others which form cross-links between the starch molecules." NGC914-1007, 2:8-16 (emphasis added). STMP has been known for decades to increase core strength in set gypsum-containing products. Indeed, Satterthwaite teaches that the inclusion of STMP "increases[s] wet

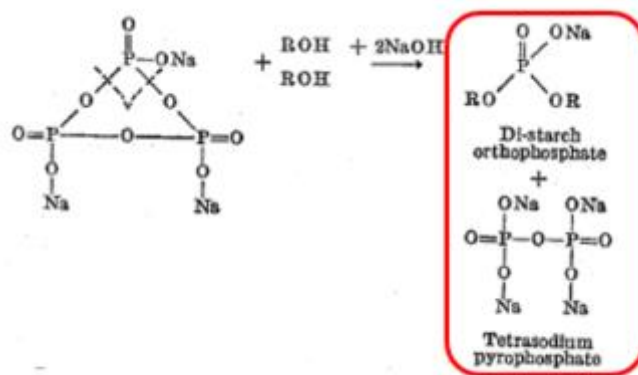
strength, increase[s] density and increase[s] resistance to warp or sag.” NGC914-1007, 1:60-63.

49. STMP reacts with starch to form permanent crosslinks between starch molecules, which results in the creation of a starch polymer called di-starch orthophosphate. This starch polymer contains covalent bonds between different starch molecules made via STMP that require a large amount of energy to break. The treatment of starch with STMP and the resulting crosslinking between the starch molecules has been known in the art since 1956 as evidenced by U.S. Patent No. 2,884,413 to Kerr (“Kerr”), which is directed to “the preparation of starch phosphate esters” and “a method of cross-linking simple starch phosphate esters.” NGC914-1010, 1:11-25. I note that this crosslinking effect resulting from the treatment of starch with STMP is also explicitly disclosed in both Graux and Satterthwaite, which are both prior art references to the ’914 patent that I discuss below. Furthermore, the ’914 patent discloses the importance of starch in set gypsum-containing products. Table 3 shows that the addition of STMP with starch enhances nail pull resistance over the control by approximately 17.3% whereas addition of STMP, alone, enhanced nail pull resistance by a moderate 5.3%. NGC914-1003, Table 3.

50. To illustrate this, I show below a representation of the chemical reaction as described by Kerr. NGC914-1010, 2:55-69. The reaction shows that

STMP and starch react to result in di-starch orthophosphate and tetrasodium pyrophosphate, which is boxed in red. The “-OR” groups attached to the phosphorus represent starch monomers.

NGC914-1010, 2:55-69.



51. In a related manner, sodium hexametaphosphate (“SHMP”) has been known in the art since 1944. U.S. Patent No. 2,346,999 to Sanford (“Sanford”) discloses the use of SHMP in the manufacture of gypsum board to improve strength and water resistance. NGC914-1021, 8:39-9:4. SHMP hydrolyzes into STMP and other molecules. NGC914-1021, 10:38-11:3. Accordingly, when SHMP is present, one of ordinary skill in the art would understand that STMP is, as a matter of basic chemistry, necessarily present. Further, the Sanford reference discloses dramatic improvements in the control of gypsum-containing core setting and strength achieved through the use of sodium metaphosphates and additional additives. Thus, the Sanford reference discloses the use of STMP as an “enhancing material” as disclosed by the ’914 patent, demonstrating that one of

ordinary skill in the art would have readily understood that STMP was a suitable enhancing material for use in set gypsum-containing products.

Accelerators

52. Another additive known to a person having ordinary skill in the art is an accelerator. Indeed, the '914 patent discloses U.S. Patent No. 3,573,947, which is directed to an accelerator for set gypsum-containing products and was filed in December of 1968. NGC914-1022, 12:53-61. Accordingly, accelerators have been known since at least the late 1960s to “shorten[] the setting time of plaster by providing seed crystals.” NGC914-1022, 2:14-16. The specification of the '914 patent makes clear that accelerators and other additives were known in the prior art, noting that “[o]ther *conventional additives* can be employed in the practice of the invention in *customary amounts* to impart desirable properties and to facilitate manufacturing, such as, for example, aqueous foam, set accelerators, set retarders, recalcination inhibitors, binders, adhesives, dispersing aids, leveling or nonleveling agents, thickeners, bactericides, fungicides, pH adjusters, colorants, reinforcing materials, fire retardants, water repellants, fillers and mixtures thereof.” NGC914-1038, 9:6-27 (emphasis added).

53. The use of an accelerator in manufacturing provides the additional advantage of increasing the strength of the resulting product. A person having ordinary skill in the art would have an excellent understanding of the use of

additives such as accelerators and the benefits accelerators confer on the final set gypsum-containing product. An accelerator facilitates the growth of gypsum crystals at a rate that provides increased gypsum core strength at the time the gypsum board is cut and, similarly, decrease the setting time of gypsum crystals.

54. Retarders temporarily slow the growth of gypsum crystals at a rate that, if added alone, provides decreased gypsum core strength at the time the gypsum board is cut and, similarly, increase the setting time of gypsum crystals. A person having ordinary skill in the art would have an excellent understanding of the use of additives such as retarders and the benefits retarders confer on the final set gypsum-containing product. In many scenarios, such as the manufacture of gypsum board, retarders extend the induction time of gypsum, which delays the time at which the gypsum begins to set and, as such, prevents shear in the mixer. As a result, the crystals are able to grow more completely, which provides increased strength to the finished gypsum board. Nevertheless, in order to prevent the gypsum board from being too weak at the knife, a mixture of accelerators and retarders must be added to ensure that the crystals grow at the appropriate time in the manufacturing process. With regard to plaster, the extended induction time caused by the retarders allows the gypsum to be manipulated without subjecting growing crystals to shear. Indeed, retarders increase the core strength of set plaster because retarders allow a greater proportion of crystals to grow undisturbed.

Indeed, a person having ordinary skill in the art would understand the optimal amounts of accelerator and retarder to be added during the gypsum manufacturing process in order to provide the benefits of the additives as described.

55. In sum, the basic ingredients of set gypsum-containing products – gypsum, water, starch, accelerators and retarders, and enhancing materials – have been well known in the art for decades. In addition, given the well-known uses for set gypsum-containing building products, the desired characteristics of those products are not surprising, and have also been well known in the art for decades. In particular, a person having ordinary skill in the art would have been very familiar with the benefits of set gypsum-containing products that are strong, sag resistant, and exhibit good dimensional stability. Therefore, it is unsurprising to me that there are numerous references that disclose the use of gypsum, water, starch, accelerators, and retarders in combination with enhancing materials, such as STMP, to produce set gypsum-containing products.

56. Since the early 1990s, and certainly at least four years before the earliest priority date for the '914 patent, there has been an increasing desire for lighter gypsum board that was still strong, sag resistant, and exhibited dimensional stability. *See* NGC914-1032.

VI. THE '914 PATENT

A. Introduction

57. The '914 patent is broadly directed to gypsum-containing building products, including “gypsum boards, reinforced gypsum composite boards, plasters, machinable materials, joint treatment materials, and acoustical tiles.” NGC914-1038, 1:26-30. More specifically, the '914 patent is directed to certain “enhancing materials” that are included to provide certain favorable characteristics in existing set gypsum-containing products. NGC914-1038, 1:40-48.

58. The '914 patent is clear that it was known that additives, such as enhancing materials and accelerators, were added for purposes of improving certain characteristics of the gypsum product including strength. *See, e.g.*, NGC914-1038, Tables 13, 14, & 15.

59. Moreover, the '914 patent specifically notes that there was industry demand for lighter products. NGC914-1038, 2:27-30. As is acknowledged by the patent, this, in turn, spawned a need for further strengthening of those lighter gypsum boards as those products utilize lower density materials, the formation of unstable air pockets, and a decrease in use of raw materials. *See* NGC914-1038, 2:27-56.

60. The '914 patent lists various additives that can be used in the gypsum manufacturing process in order to provide increased sag resistance and

compressive strength. *See* NGC914-1038, Tables 11-13. The patent, however, focuses on one enhancing agent in particular: STMP. NGC914-1038, 4:17-26. The specification is clear in that the purportedly novel aspect of the patent is limited to the addition of STMP to the method of manufacturing of the set gypsum-containing products. Indeed, the specification of the '914 patent repeatedly makes this point:

The present invention can be practiced employing compositions and methods similar to those employed in the prior art to prepare various set gypsum-containing products. *The essential difference in the compositions and methods of some preferred embodiments of this invention from compositions and methods employed in the prior art to prepare various set gypsum-containing products is that a trimetaphosphate salt is included to provide that in methods of the invention the rehydration of calcined gypsum to form set gypsum takes place in the presence of trimetaphosphate ion and thereby produces the benefits of the invention.* In other respects the compositions and methods of the invention can be the same as the corresponding compositions and methods of the prior art.

NGC914-1038, 7:50-62 (emphasis added).

In some preferred inventive embodiments wherein the method and composition are for preparing gypsum board comprising a core of set gypsum-containing *material* sandwiched between cover sheets, trimetaphosphate ion is employed in the concentrations and manner described above. *In other respects, the composition and method can*

be practiced with the same components and in the same manner as the corresponding compositions and methods for preparing gypsum board of the prior art, for example, as described in U.S. Pat. Nos. 4,009,062 and 2,985,219, the disclosures of which are incorporated herein by reference.

NGC914-1038, 9:14-37 (emphasis added); NGC914-1023; NGC914-1017.

The method comprises forming such a mixture, depositing it on a surface or into a mold, and allowing it to set and dry. In other respects, the composition and method can be practiced with the same components and in the same manner as the corresponding compositions and methods for preparing composite board of the prior art, for example, as described in U.S. Pat. No. 5,320,677, the disclosure of which is incorporated herein by reference.

NGC914-1038, 11:4-11 (emphasis added); NGC914-1024.

In respect to aspects other than the inclusion of trimetaphosphate salts and ions, the composition and method can be practiced with the same components and in the same manner as the corresponding compositions and methods for preparing machinable plaster material of the prior art, for example, as described in U.S. Pat. No. 5,534,059, the disclosure of which is incorporated herein by reference.

NGC914-1038, 11:23-30 (emphasis added); NGC914-1025.

In respect to aspects other than the inclusion of trimetaphosphate ion, the composition and method can be practiced with the same components and in the same manner as the corresponding compositions and methods for producing an acoustical tile of the prior

art, for example, as described in U.S. Pat. Nos. 5,395,438 and 3,246,063, the disclosures of which are incorporated herein by reference.

NGC914-1038, 12:11-16 (emphasis added); NGC914-1026; NGC914-1027.

Paper-covered foamed gypsum boards were prepared on a typical full scale production line in a commercial gypsum board manufacturing facility. Boards were prepared with various concentrations of trimetaphosphate ion and were compared with control boards (prepared without trimetaphosphate ion) in regard to dimensional stability and resistance to permanent deformation. *Except for the inclusion of trimetaphosphate ion in the preparation of some of the boards*, the boards were prepared using methods and ingredients typical of prior art gypsum board production methods and ingredients.

NGC914-1038, 17:30-40 (emphasis added).

Another set of paper-covered foamed gypsum boards was prepared on a typical full scale production line in a gypsum board manufacturing facility. Boards were prepared with three concentrations of trimetaphosphate ion and were compared with control boards (prepared without trimetaphosphate ion) in regard to nail pull resistance. *Except for the inclusion of trimetaphosphate ion in the preparation of some of the boards*, the boards were prepared using methods and ingredients typical of prior art gypsum board production methods and ingredients.

NGC914-1038, 20:49-58 (emphasis added).

Another set of paper-covered foamed gypsum boards was prepared on a typical full scale production line in a gypsum board manufacturing facility. Boards were prepared with various concentrations of trimetaphosphate ion, pregelatinized starch, and non-pregelatinized starch and were compared with control boards (prepared without trimetaphosphate ion or pregelatinized starch) in regard to the integrity of the bond between the gypsum board core and its face cover paper after conditioning under extremely wet and humidified conditions. *Except for the inclusion of trimetaphosphate ion and pregelatinized starch and the varying of the concentration of non-pregelatinized starch in the preparation of some of the boards, the boards were prepared using methods and ingredients typical of prior art gypsum board production methods and ingredients.*

NGC914-1038, 23:25-38 (emphasis added).

61. The '914 patent lists various improvements that result from the use of STMP, but provides no explanation as to how any of the claimed enhancing materials were discovered. *See, e.g.*, NGC914-1038, Table 1, Table 2, & Table 3. Indeed, the '914 patent states that STMP can be added to the wet gypsum mixture at various stages and by various methods: the STMP can be added to the “mixing apparatus,” it can be sprayed onto the gypsum before the second cover sheet is laid down, it can be used to “pre-coat” the gypsum, it can be added to raw gypsum, and it can even be dissolved in water, starch, etc. and sprayed onto an already-set gypsum-containing board. NGC914-1038, 8:19-9:5. Moreover, the '914 patent

states repeatedly that the results were unexpected and it is unknown why the products present these improved attributes. NGC914-1038, 3:60-64, 5:4-14.

62. Moreover, the claims provide little more than a well-known and basic recipe for a set gypsum-containing product – calcined gypsum, water, accelerator, starch, foam, and one or more enhancing materials. The claims do not provide any guidance as to quantity, merely relying on the knowledge of a person having ordinary skill in the art to provide sufficient enhancing material to provide a known “sag resistance,” and sufficient accelerator to improve strength. Claim 1 provides a range of concentrations of the “enhancing material,” but does so with reference to an extremely large range of values such that the limitation is effectively meaningless.

63. The '914 patent claims a broad category of “condensed phosphates” that purportedly serve as enhancing materials to be used in the gypsum manufacturing process in order to provide increased sag resistance and compressive strength. NGC914-1038, Claim 1; *see also* NGC914-1038, 2:27-61. However, as stated, the '914 patent focuses on the benefits of the addition of only one particular member of this category of phosphates: STMP. It, therefore, appears that the claims of the patent are far broader than the disclosure of the specification.

64. However, as described in greater detail below, the use of enhancing

materials was well known in the industry well-before the earliest alleged priority date of the '914 patent. Moreover, and as stated, it was obvious to use existing enhancing materials, such as STMP, to address strength, humidified sag resistance, and dimensional stability. In particular, references predating the earliest priority date of the challenged claims, by, in some cases, several decades, disclose the use of STMP. Indeed, Knauf discloses the addition of “phosphates and polyphosphates such as sodium tripolyphosphate . . . , sodium trimetaphosphate . . . , and Graham’s salt” NGC914-1011, 1:65-2:2. Finally, persons of skill in the art in fact did know additives like STMP and boric acid increased compressive strength and sag resistance, in particular because, as previously discussed, salt in natural gypsum causes it to sag, but additives like STMP and boric acid eliminate sag by ameliorating the effects of salt in the natural gypsum. In particular, additives like STMP alter the crystallization reaction time. A person having ordinary skill in the art would understand that, as with many reagents, the accelerating and retarding effects of STMP vary based on pH. Indeed, a person having ordinary skill in the art would understand that at a high pH, STMP acts as a retarder, and at a lower pH, STMP acts as an accelerator. For example, at a high pH when STMP acts as a retarder (e.g., in plaster applications), STMP extends the induction time of gypsum, which delays the time at which the gypsum begins to set and, as such, allows the gypsum to be manipulated without subjecting growing crystals to shear.

Indeed, STMP increases the core strength of the set gypsum-containing product because it allows a greater proportion of crystals to grow undisturbed. However, at a lower pH when STMP acts as an accelerator (e.g., in gypsum board manufacture), STMP decreases the setting time for gypsum crystals, which increases the core strength of the gypsum-containing product at the time the gypsum-containing product is cut. This undermines the purported mystery described in the specification, and further evidences the lack of any true invention claimed by the '914 patent. Accordingly, the improvements recited in the '914 patent are a well-known consequence of using enhancing materials generally, and the benefits of using STMP, in particular, were also known.

B. Prosecution History of the '914 Patent

65. In the family of patents that includes the '914 patent, only two applications were substantively examined: U.S. Application No. 09/138,355 (that ultimately issued as the '284 patent) and U.S. Application No. 09/249,814 (that ultimately issued as the '550 patent). The examination of these two applications was nearly identical, and the pending claims in both applications were rejected as obvious over U.S. Patent No. 3,770,468 to Knauf and U.S. Patent No. 4,126,599 to Sugahara. NGC914-1004; NGC914-1005. In the examination of both applications, the applicant made similar arguments and amendments to distinguish its alleged invention, including inexplicably that the cited references do not

disclose the “condensed phosphoric acids, and/or the condensed phosphates as described and claimed by applicants,” despite the fact that the prior art references disclose STMP. *See, e.g.*, NGC914-1004, 9; NGC914-1005, 7. Ultimately, it appears that Patent Owner convinced the examiner of patentability by focusing on specific embodiments and characteristics of the finished products, and not because it had claimed a novel composition.

66. It is worth noting that the applicant specifically distinguished Sugahara by arguing that in its alleged invention “the enhancing material is added to the mixture comprising calcined gypsum. In contrast, in Sugahara, the polybasic acid is not added to the calcined gypsum mixture used to form the set gypsum product. Sugahara only teaches applying a solution of polybasic acid to the hardened set gypsum product.” NGC914-1005, 25. Even if this is a meaningful distinction, the prior art cited in this petition disclose that an enhancing material – STMP – is added to the mixture comprising calcined gypsum.

67. The file histories for the additional patents in this family do not reflect any substantive rejections over any prior art. None of Graux, Satterthwaite, ASTM C 473-95, and Hjelmeland were considered by the examiner during the examination of the application for the ’914 patent. I have been informed by counsel that Sucech, Baig, and Summerfield were disclosed to the PTO during prosecution. Moreover, I note that Sucech, Baig, and Summerfield were cited in

the specification of the '914 patent, and Baig and Summerfield were also discussed in the specification of the '914 patent. However, the references were not cited in an Office Action or referred to during prosecution. I further understand that the fact that a reference was disclosed to the PTO does not preclude use of it for an IPR.

C. The Challenged Claims

68. Claims 1-4, 6, 8, and 10 (“the Challenged Claims”) are challenged in this Petition and are reproduced below.

1. [preamble] A gypsum board comprising:

[1a] a core of material sandwiched between cover sheets, wherein the core comprises an interlocking matrix of set gypsum, and the board has been prepared by a method comprising,

[1b] forming or depositing a mixture between the cover sheets, wherein the mixture comprises a calcined gypsum, water, an accelerator, and one or more enhancing materials selected from the group consisting of: sodium trimetaphosphate, tetrapotassium pyrophosphate, tetrasodium pyrophosphate, aluminum trimetaphosphate, sodium acid pyrophosphate, ammonium polyphosphate having 1000-3000 repeating phosphate units, and acids, salts, or the anionic portions thereof, and,

[1c] maintaining the mixture under conditions sufficient for the calcined gypsum to form the interlocking matrix of set gypsum,

[1d] the enhancing material or materials having been included in the mixture in an amount such that the gypsum board has greater sag resistance than it would have if the enhancing material had not been included in the mixture.

[1e] said board having a sag resistance as determined according to ASTM C473-95 of less than about 0.1 inch per two foot length of said board,

[1f] the accelerator having been included in an amount such that the gypsum board has greater strength than it would have if the accelerator had not been included in the mixture.

2. The gypsum board of claim 1, wherein the concentration of the enhancing material in the mixture is from 0.004 to 2.0 percent by weight, based on the weight of the calcined gypsum.
3. The gypsum board of claim 1, wherein the calcined gypsum comprises one or more of: calcium sulfate anhydrite; calcium sulfate hemihydrate; or ions of calcium and sulfate.
4. The gypsum board of claim 1, wherein the enhancing material comprises one or more of the following salts, or the anionic portions thereof: sodium trimetaphosphate and ammonium polyphosphate having 1000-3000 repeating phosphate units.
6. The gypsum board of claim 1, wherein the mixture further comprises a pregelatinized starch.
8. The gypsum board of claim 1, wherein: the core has voids uniformly distributed therein; and the mixture further comprises an aqueous foam.
10. The gypsum board of claim 1, wherein the mixture further comprises a pregelatinized starch and an aqueous foam.

D. Priority Date

69. I understand from the face of the '914 patent that the purported priority date for the '914 Patent is August 21, 1997. I also understand that at least prior art references published on or before August 21, 1997 are considered prior art to the '914 Patent, and this is the date I have used for my analysis.

VII. CLAIM INTERPRETATION OF THE '914 PATENT

70. In my review of the claims of the '914 patent I understand that the following terms, after the expiration of the patent, should be given ordinary and customary meanings, as would be understood by a person having ordinary skill in the art, at the time of the invention, having taken into consideration the language of the claims, the specification, and the prosecution history of record. I applied this standard in my analysis below for all of the claim terms.

i. Enhancing Material

71. The specification of the '914 patent is clear that an enhancing material provides “improved properties and advantages in preparing the set gypsum-containing products.” NGC914-1038, 1:40-42. The specification is further clear that three properties are affected by an enhancing material: strength, resistance to permanent deformation (e.g., sag resistance), and dimensional stability (e.g., non-shrinkage during drying of set gypsum). NGC914-1038, 1:42-47. However, the specification does not state that the enhancing material must affect all three properties. To the contrary, the specification is explicit that an enhancing material does *not* have to improve all three properties. Indeed, the specification states that

[i]n general, any enhancing materials that fall within the general definition of enhancing materials previously discussed will produce beneficial results (e.g., increased resistance to permanent deformation) in treatment of calcined gypsum. The generally useful enhancing

materials are condensed phosphoric acids, each of which comprises 2 or more phosphoric acid units; and salts or ions of condensed phosphates, each of which comprises 2 or more phosphate units.

NGC914-1038, 27:39-47.

72. The specification discusses enhancing materials and their effects in Tables 13-15 and 16. With respect to Tables 13-15, however, the specification states that “[t]he results . . . show that all materials tested that are within the definition of enhancing materials above . . . cause the products to exhibit significant *resistance to permanent deformation* compared with the controls.” NGC914-1038, 28:62-68. There is no mention of increased strength and increased dimensional stability. Indeed, Table 13 discloses that sodium hexametaphosphate actually *decreases* the strength of gypsum by nearly 100 psi.

73. Moreover, with respect to Table 16, the specification states that “[t]he results . . . show that all materials tested that are within the definition of enhancing materials above . . . cause the resulting products to exhibit *significant resistance to permanent deformation and significant resistance to strength* compared with the controls. NGC914-1038, 31:30-35 (emphasis added). There is no mention of increased dimensional stability.

74. Furthermore, and as previously stated, the specification notes that there was a need in the art for set gypsum-containing products to have greater dimensional stability, resistance to sag, and strength. In reference to these “needs,”

the specification states that “[e]ach embodiment of the invention meets *one or more of these needs*.” NGC914-1038, 3:30-64 (emphasis added). The specification further states that “in general, *some preferred embodiments of the invention* provide a method for producing a set gypsum-containing product having increased strength, resistance to permanent deformation (e.g., sag resistance), and dimensional stability” NGC914-1038, 4:55-59 (emphasis added).

75. Accordingly, a person having ordinary skill in the art would construe an “enhancing material” under the standard applied to expired patents as an additive that improves at least one of resistance to permanent deformation, strength, and dimensional stability in set gypsum-containing products. Indeed, an acceptable broader construction could be *any* ingredient that simply improves or “enhances” a characteristic of the set-gypsum containing product. However, given the specific disclosure of the specification, I believe it is appropriate to limit this term to one or more of the specific improvements identified in the specification.

76. Patent Owner may argue that it narrowly defined this term so that the claim term “enhancing materials” is limited to the specific chemicals listed in various locations in the ’914 patent. Based on my review of the ’914 patent, however, I do not believe that one of ordinary skill in the art would understand the Patent Owner to have clearly defined the term “enhancing materials” in such a

narrow manner. To the contrary, one of ordinary skill in the art would have understood that the specific chemicals listed in various locations of the '914 patent were non-limiting examples of materials that may, in some regards, improve one or more of sag resistance, strength, and/or dimensional stability. Indeed, a construction of “enhancing materials” that is limited to a list of particular chemicals or categories of chemicals cannot be correct in view of the language of the claims. Specifically, each of the challenged claims require that the claimed “enhancing material” is chosen from an enumerated group, which necessarily means that the term “enhancing materials” must include more materials than those listed. For example, claim 1 of the '914 patent specifies that the “enhancing materials” that fall within the scope of the claim are limited to only “sodium trimetaphosphate, tetrapotassium pyrophosphate, tetrasodium pyrophosphate, aluminum trimetaphosphate, sodium acid pyrophosphate, ammonium polyphosphate having 1000-3000 repeating phosphate units, and acids, salts, or the anionic portions thereof.” NGC914-1038, Claim 1. Thus, a person having ordinary skill in the art would understand that, the standard applied to expired patents, the term “enhancing materials” must include more than just those chemicals, as to construe those terms as being coextensive with one another would render the claim language redundant

ii. Accelerator

77. The specification of the related '550 patent states that an accelerator can be “[a]ny of the materials known to be useful to accelerate the rate of formation of set gypsum.” NGC914-1002, 35:20-40. The specification of both the '550 patent and the '914 patent states that “finely ground sugar-coated particles of calcium sulfate dihydrate” is a preferred accelerator. NGC914-1002, 14:32-52; NGC914-1038, 17:59-63. The '550 patent further describes an example in which an accelerator is used in conjunction with an enhancing material to overcome the retardant and weakening effects the enhancing material had on the product. NGC914-1002, 35:3-40. Accordingly, a person having ordinary skill in the art would understand an accelerator to mean any reagent or combination of reagents known to be useful to influence the rate of formation of set gypsum. Because the specification is clear in the use of the term, I believe that the meaning of “accelerator” will be unchanged under the standard applied to expired patents.

VIII. GROUND 1: OBVIOUSNESS OF CLAIMS 1-4, 6, 8, AND 10 BASED ON GRAUX IN VIEW OF ASTM C473-95, HJELMELAND, SUCECH AND SUMMERFIELD

78. Graux teaches the ingredients of the set gypsum-containing product described in the claims, including calcined gypsum, water, starch, and one or more enhancing materials. The additional elements recited in the claims merely disclose the natural consequence of combining those ingredients. However, those

additional natural consequences are further described in Hjelmeland and ASTM C473-95. Hjelmeland discloses including the one or more enhancing materials in an amount of “0.01-0.2% by weight.” NGC914-1008, 4:11-15. ASTM C473-95 discloses test methods for determining various properties of gypsum products, including humidified deflection (*i.e.* sag resistance). NGC914-1009, at ¶ 49. Sucech and Summerfield are only being used for certain claims that recite specific elements that USG admits existed in the prior art in the specification of the ’914 patent. The chart below shows the combinations of references being used to invalidate each element of the challenged claims.

Claim Limitation	Reference
1a	Graux, Summerfield
1b	Graux, Summerfield
1c	Graux
1d	Graux, Summerfield
1e	Graux
1f	Graux, ASTM
1g	Graux, Hjelmeland
2	Graux, Hjelmeland
3	Graux
4	Graux
6	Graux
8	Graux, Sucech
10	Graux, Sucech

A. Graux

79. U.S. Patent No. 5,932,001 to Graux et al. (“Graux”) was filed on May 9, 1997, and issued on August 3, 1999. Graux was not before the Examiner during

prosecution of the '914 patent.

80. Graux is directed to set gypsum-containing products including a cationic amylaceous compound. NGC914-1006, 1:4-5; NGC914-1006, 3:8-12. It is important to understand that the term “plaster” in the Graux patent has more than one meaning. This is illustrated, for example, in Graux, which discloses that “[t]he present invention relates to a new plaster, coating or adhesive composition based on plaster, containing an amylaceous compound.” NGC914-1006, Abstract. In Europe, which is where the Graux patent originated, the term “plaster” is used to describe both (i) the materials described in the United States as “stucco,” which includes, amongst other things, calcined gypsum and (ii) finished articles including hydrated “plaster” or “stucco,” such as gypsum board or plaster being capable of being spread by a trowel, and any composition containing “more or less fluid pastes, hardened pastes or finished articles of all forms, properties (including mechanical properties, density and porosity) and intended uses.” NGC914-1006, 1:6-9; 1:12-30. Indeed, the European term for “gypsum board” is “plaster board.”

81. Graux states that while “[t]he use of cationic amylaceous compounds is not new in itself,” many of the known cationic amylaceous compounds” have only a limited thickening capacity and . . . are unable to meet the current demands of the art.” NGC914-1006, 3:13-35. Thus, the object of Graux is to provide a set gypsum-containing product having improved thickening capacity, NGC914-1006,

3:40-45, and a process for the preparation of said set gypsum-containing product. NGC914-1006, 8:15.

82. The set gypsum-containing product disclosed by Graux includes “finished articles,” NGC914-1006, 1:35-39, made from a “form of calcium sulphate” including gypsum and “calcined/rehydrated forms.” NGC914-1006, 1:24-30. The set gypsum-containing product contains calcined gypsum mixed with water and other additives, including “accelerators such as, . . . , gypsum,” NGC914-1006, 7:32-33, and a starch “crosslinked with sodium trimetaphosphate.” NGC914-1006, 9:29-30, which can be gelatinized in a drum, NGC914-1006, 6:17-44. The resulting mixture is then allowed to set. NGC914-1006, 1:55-58; NGC914-1006, 9:39-46.

B. ASTM C473-95

83. ASTM C473-95 entitled *Standard Test Methods for Physical Testing of Gypsum Board Products and Gypsum Lath* was the testing standard for gypsum products in 1995, although the same tests as those provided by ASTM C473-95 were used at least as early as 1981, NGC914-1031, and some version of ASTM C473 existed as early as 1961. NGC914-1009, 1, n.1. Moreover, the '914 patent repeatedly identifies ASTM C473-95 as being the known testing standard at the time the '914 patent was filed. *See, e.g.*, NGC914-1038, 18:59-67.

84. ASTM C473-95 provides test methods for measuring various

characteristics of gypsum products, including humidified deflection (*i.e.* sag resistance), hardness, and nail pull resistance. NGC914-1009. As previously discussed, the humidified deflection test is used to “evaluat[e] the deflection of gypsum board or gypsum lath when horizontally suspended and subjected to high humidity.” NGC914-1009, at ¶ 49. Additionally, the hardness test is used for “evaluating the relative ability of gypsum board or gypsum lath core, ends, and edges to resist crushing during handling or use of the material.” NGC914-1009, at ¶ 9. Further, the nail pull resistance test is used for “evaluating the ability of gypsum board or gypsum lath to resist nail pull-through by determining the load required to force a standard nailhead through the board or lath.” NGC914-1009, at ¶ 18.

C. Hjelmeland

85. U.S. Patent No. 5,980,628 to Hjelmeland et al. (“Hjelmeland”) claims priority to PCT Application No. PCT/NO96/00116 filed May 14, 1996 and published December 5, 1996. Hjelmeland was not before the Examiner during prosecution of the ’914 patent.

86. Hjelmeland is directed to set gypsum products. NGC914-1008, 1:6-7. Hjelmeland states that existing set gypsum products either “creep” after application or harden “in mixer units and pumps and lead to clogging or blocking of the equipment.” NGC914-1008, 1:22-31. Thus, the stated object of Hjelmeland is to

teach “a curable gypsum-based composition for the production of cured gypsum, enabling an efficient use of gypsum as material in . . . building constructions.” NGC914-1008, 3:16-19.

87. The set gypsum product disclosed by Hjelmeland includes “a set retarding substance comprising (i) an organic acid containing at least two acid groups selected from the group consisting of . . . phosphate or phosphonate . . . and/or (ii) inorganic anions selected from the group consisting of polyphosphate” NGC914-1008, 3:60-4:2. Hjelmeland further discloses that “the set retarding substance constitutes . . . 0.01-0.2% . . . by weight of the gross water quantity in the first component.” NGC914-1008, 4:13-15. Accordingly, a person having ordinary skill in the art would further understand that Hjelmeland discloses the addition of the “set retarding substance” in the claimed range. Further, a person having ordinary skill in the art would understand that the “set retarding substance” of Hjelmeland includes STMP.

88. Although Hjelmeland discloses STMP as a “set retarding substance,” a person having ordinary skill in the art would understand that, as with many reagents, the accelerating and retarding effects of STMP vary based on pH. Indeed, a person having ordinary skill in the art would understand that at a high pH STMP acts as a retarder, and at a lower pH STMP acts as an accelerator. A person having ordinary skill in the art would also understand that Hjelmeland is primarily

directed to the use of plaster, which has a high pH. As such, a person having ordinary skill in the art would understand that because the plaster is at a high pH, STMP acts as a retarder. Moreover, a person having ordinary skill in the art would understand that Hjelmeland uses the term “set retarding substance” to refer to STMP’s ability to extend the induction time of gypsum, which delays the time at which the gypsum begins to set and, as such, allows the gypsum to be manipulated without subjecting growing crystals to shear. Indeed, STMP increases the core strength of the set gypsum product because it allows a greater proportion of crystals to grow undisturbed. In this regard, a person having ordinary skill in the art would understand that Hjelmeland teaches an interaction between STMP and gypsum that results in a product with at least increased core strength

D. Sucech

89. U.S. Patent No. 5,643,510 to Sucech (“Sucech”) was filed on February 8, 1996, and issued on July 1, 1997. NGC914-1036. Sucech was disclosed to the PTO during the prosecution of the ’914 patent, but was not cited in an Office Action or referred to during prosecution. Sucech is directed to a “process and foaming system for producing foamed gypsum board which permits the production and control of large foam voids in the gypsum core by adjusting the ratio of a first foaming agent and a second foaming agent” in order to develop lighter board. NGC914-1036, Abstract. Sucech teaches processes for incorporating foaming

agents into the gypsum mixtures. NGC914-1036, 2:26-29.

E. Summerfield

90. U.S. Patent No. 2,985,219 to Summerfield (“Summerfield”) was filed on December 29, 1958, and issued on May 23, 1961. NGC914-1017.

Summerfield states that one object of the invention is to disclose “a process and apparatus for making plasterboard which is readily adaptable to present day commercial machines and methods.” NGC914-1017, 3:33-37. Summerfield further discloses the basic process for making gypsum boards, which include mixing a gypsum-containing slurry, depositing the slurry onto a sheet of paper, covering the slurry with another sheet of paper, allowing the slurry to set, cutting the slurry into the desired size, and drying the slurry in a kiln. NGC914-1017, 1:17-30.

F. Motivation To Combine Graux, ASTM C473-95, and Hjelmeland, Sucech, and Summerfield

91. The '914 patent essentially emphasizes three points relevant to gypsum containing products. First, the specification notes there is a “continuing effort” to make set gypsum products lighter, and notes that the natural consequence of that is a need to increase the strength of the product beyond normal levels to increase overall strength. NGC914-1038, 2:27-35. Second, the specification notes that under high humidity conditions, there is a need for greater sag resistance. NGC914-1038, 2:45-50. Third, the specification describes a need for greater

dimensional stability to limit shrinking or expanding of the product, particularly under conditions of changing temperature and humidity. NGC914-1038, 2:57-61.

The '914 patent purports to solve at least one of these issues through the use of allegedly novel gypsum compositions that incorporate certain “enhancing materials” to reduce sag. However, the enhancing material of the claims of the '914 patent does not appear to be directed to improving the dimensional stability of the set gypsum product.

92. As introduced above and described in greater detail below, Graux discloses a plaster composition including each of the ingredients identified in the claimed composition. In particular, Graux discloses a plaster composition containing calcined gypsum, NGC914-1006, 1:24-30, water, NGC914-1006, 9:29-30, and STMP, NGC194-1006, 10:29-30. A person having ordinary skill in the art would know that STMP is added for a reason. Indeed, in my experience in the industrial manufacture of gypsum containing products, any additional ingredient that was added to the composition was done for the specific purpose of improving some characteristic of the product. Enhancing materials, for example, were included to, among other things, increase sag resistance.

93. I agree with the notion presented in the specification of the '914 patent that at that time there was a “continuing effort” to make products lighter, which in turn required greater strength. At least as early as the 1990s, the gypsum product

industry was focused on making lighter products to limit freight costs and create products that were easier to install. I also agree that sag resistance and dimensional stability were also concerns at the time, as these have always been the problems that result when set gypsum products come into contact with water and/or humidity.

94. A person having ordinary skill in the art would also have been very experienced and knowledgeable about ASTM C473-95 and similar testing methods and would have known the specific tests for testing compressive strength, sag resistance, and dimensional stability. *See, e.g.*, NGC914-1014, and NGC914-1009. In particular, in light of these ASTM tests specifying the characteristics that are indicative of a quality gypsum product, a person having ordinary skill in the art would have been motivated to utilize STMP and accelerators disclosed in Graux. In other words, it would have been obvious for a person having ordinary skill in the art to at least try the predictable solutions described in Graux, and there would have been a reasonable expectation that those ingredients would have yielded a product that provided the required sag resistance described in the claim.

95. The obviousness of the combination and predictable outcome is heightened in this case because Graux and ASTM C473-95 are in the very same field. In particular, both references relate to gypsum products, with Graux being directed to set gypsum products having enhancing materials for improving water

and sag resistance, and ASTM C473-95 being directed to measuring the sag resistance of such products. Moreover, as noted above, the '914 patent repeatedly identifies ASTM C473-95 as being the known testing standard at the time the '914 patent was filed. NGC914-1038, 18:59-67. As such, a person having ordinary skill in the art would know that the gypsum products described in Graux are tested for sag resistance using ASTM C473-95, and would therefore have a reasonable expectation of success in achieving the characteristics described in ASTM C473-95.

96. Still further, Hjelmeland discloses a set gypsum product including “a first component comprising calcined gypsum suspended in water, and a set retarding substance comprising . . . inorganic anions selected from the group consisting of polyphosphate and polyborate, or mixtures thereof,” NGC914-1008, 3:60-4:3, and containing the set retarding substance in an amount of “0.01-0.2% by weight of the gross water quantity in the first component.” NGC914-1008, 4:13-15. A person having ordinary skill in the art would understand that the set retarding substance of Hjelmeland is a condensed phosphoric acid or ion of a condensed phosphate. Moreover, a person having ordinary skill in the art would understand that STMP, as disclosed by Graux, is a salt of a condensed phosphate. As such, a person having ordinary skill in the art, understanding the similarities between Hjelmeland, which discloses the amount of condensed phosphoric acid or

ion of condensed phosphate to include in a set gypsum product, NGC914-1008, 4:13-15, and Graux, would find it obvious to use the amount of condensed phosphate specified by Hjelmeland in the set gypsum products of Graux because both references disclose a recipe for gypsum-containing product that includes STMP in order to achieve certain beneficial properties. Furthermore, a person having ordinary skill in the art would have a reasonable expectation of success in combining the references.

97. Moreover, Sucech, which is cited in the specification of the '914 patent, discloses the use of foaming agents in order to “produce[] a multiplicity of large voids substantially uniformly distributed throughout the foamed gypsum core” in set gypsum-containing products. NGC914-1036, 5:12-14. Indeed, a person having ordinary skill in the art would understand that foaming agents are commonly used in set gypsum-containing products in order to control the density of the products, which, in turn, helps provide strength to the set gypsum-containing products while lowering their weight and bulk density. As such, a person having ordinary skill in the art, understanding the similarities between Sucech, which discloses the use of foaming agents in production of set gypsum-containing products to lower their weight and density, NGC914-1036, 1:30-35, 5:12-14, and Graux, would find it obvious to add a foaming agent as taught by Sucech to the set gypsum-containing products of Graux and would have a reasonable expectation of

success in doing so. Indeed, this is precisely what Patent Owner did in the specification of the '914 patent when it pointed to Sucech as evidence that “[m]any such foaming agents are well known and readily commercially available.” NGC914-1038, 10:52-63.

98. Moreover, Summerfield, which is discussed in the specification of the '914 patent, discloses the basic process for manufacturing set gypsum-containing products, including gypsum board. NGC914-1017, 1:13-35. In particular, Summerfield discloses a gypsum-containing slurry that flows out onto paper and is topped off with another sheet of paper. NGC914-1017, 1:17-30. As such, a person having ordinary skill in the art, understanding the similarities between Summerfield, which discloses the basic process of manufacturing gypsum board, NGC914-1017, 1:13-35, and Graux, would find it obvious to manufacture the set gypsum-containing products of Graux with paper coverings as taught by Summerfield and would have a reasonable expectation of success in doing so. Indeed, in the specification of the '914 patent, Patent Owner repeatedly cites to Summerfield to demonstrate that “set gypsum is the major component of paper-faced gypsum boards employed in typical drywall construction of interior walls and ceilings of buildings.” NGC914-1038, 1:55-66.

99. Each of Graux, ASTM C473-95, Hjelmeland, Sucech, and Summerfield are narrowly and directly related to improvements of certain specific

and well-known properties of set gypsum-containing products. In particular, Graux, ASTM C473-95, Hjelmeland, Sucech, and Summerfield disclose additives or processes for improving the strength, sag resistance, and/or dimensional stability of set gypsum-containing products, including the use of various enhancing materials, foams, host particles, paper coverings and the like. Given the similarities between the problem to be solved by Graux, ASTM C473-95, Hjelmeland, Sucech, and Summerfield and the similarities in the solution itself, a person having ordinary skill in the art would have a reasonable expectation of success in combining the teachings of ASTM C473-95, Hjelmeland, Sucech, and Summerfield with the teachings of Graux.

100. Given the similarities between the problem to be solved by Graux, ASTM C473-95, Hjelmeland, Sucech, and Summerfield and the similarities in the solution itself, a person having ordinary skill in the art would have a reasonable expectation of success in combining the teachings of ASTM C473-95, Hjelmeland, Sucech, and Summerfield with the teachings of Graux.

101. A person having ordinary skill in the art would readily reach to the teaching of one or more of these references because they describe the same products, and each are directed to improving characteristics that were known as desirable in the industry. This is evidenced by the specification of the '914 patent. When Patent Owner wished to express that certain aspects of its formulation were

known, it pointed to related references in the prior art that taught a specific ingredient or element of its disclosed product. Petitioner relies on certain of the same references here. Petitioner also relies on additional references apparently unknown to Patent Owner and the examiner, but combines those in the same way as Patent Owner did for the Sucech, and Summerfield references. Patent Owner's citation of Sucech, and Summerfield in the specification of the '914 patent, itself, is an admission that the teachings of at least these references were known to persons having ordinary skill in the arts, were part of the body of the prior art, and would readily be a component of an obvious combination. As described further above and below, Petitioner identifies certain additional references that are readily combined in the same way.

102. To the extent any modifications of the features of Graux, ASTM C473-95, Hjelmeland, Sucech, and Summerfield would have been necessary, such modification would have been well within the skill of the person having ordinary skill in the art as the set gypsum products disclosed by the references are compatible and chemically similar. Indeed, the challenged claims appear to directly support this conclusion to the extent that they do not recite specific amounts, but instead simply require an enhancing material "in an amount such that the gypsum board has greater sag resistance". As such, the claims themselves contemplate that little more than the ingredients would be known, and otherwise

expect those amounts to either be readily known or readily determined by a person having ordinary skill in the art. Petitioner notes that Sucech and Summerfield are only being used for certain claims that recite specific elements. Indeed, USG admits that these claim elements existed in the prior art in the specification of the '914 patent.

G. Element by Element Analysis

i. Claim 1a: A gypsum board comprising

103. Graux discloses “a new plaster composition” wherein “[t]he term ‘plaster’ means . . . all building plasters, plasters for special building purposes, plasters for prefabrication and moulding plasters for the arts and industry.” NGC914-1006, 1:6-9. Graux also discloses that this composition is “set” as it discloses “[f]or the preparation of these articles, it is compulsory that the amylaceous compounds have no detrimental influence on the fluidity, the hardening or the setting” of the composition. NGC914-1006, 1:55-58. Graux discloses that the compositions “must be considered . . . in the form of finished articles of all forms, properties . . . and intended uses,” which necessarily includes prefabricated products like gypsum board. NGC914-1006, 1:24-30. Graux further discloses that compositions produced by this method include gypsum. NGC914-1006, 1:35-39. Graux discloses that the gypsum included in the composition can take several forms: “[t]he origin, nature and concentration of any form of calcium

sulphate contained in the plaster (dihydrate form gypsum, hydrated forms, particularly hemihydrates, calcined/rehydrated forms, anhydrous forms, . . .) are in no way limiting within the context of the present invention.” NGC914-1006, 1:35-39. Accordingly, a person having ordinary skill in the art would understand that Graux discloses this claim element.

ii. Claim 1b: a core of material sandwiched between cover sheets, wherein the core comprises an interlocking matrix of set gypsum,

104. All that this claim discloses is the basic preparation of gypsum board: a gypsum-containing slurry is deposited onto a sheet of paper and is covered with another sheet of paper. As the board travels down the line, the gypsum-containing slurry sets and becomes an interlocking matrix. Accordingly, this claim limitation would have been obvious in light of the knowledge of a person having ordinary skill in the art.

105. Moreover, the specification of the '914 patent discloses this as it discloses Summerfield, which is directed to manufacturing plasterboard from gypsum. NGC914-1017, 1:13-35; NGC914-1038, 9:19-27. Summerfield discloses the basic method of manufacturing plasterboard as it states that

[A]n aqueous slurry of calcined gypsum is continuously deposited on a moving sheet of paper which constitutes one cover for the final product. The slurry so deposited is leveled by a roller and a second cover sheet is simultaneously applied and one of the cover sheets may

be folded over the edge of the unset slurry. The gypsum forming the core between the opposed sheets is allowed to set and the resulting board is cut to a desired length and passed through a drying kiln in which the excess water is removed.

NGC914-1017, 1:17-30 (emphasis added). A person having ordinary skill in the art would be motivated to combine the teachings of Summerfield with Graux at least because, as stated, Summerfield is disclosed in the '914 patent and because both references are in the same field. Indeed, a person having ordinary skill in the art would be motivated to combine, with a reasonable expectation of success, the disclosure of Summerfield with Graux.

106. Further still, Graux discloses that the gypsum-containing slurry sets to become an interlocking matrix. Indeed, Graux discloses that the “compositions according to the invention must be considered both in the form of powders, these being ready to use or otherwise, and in the form of, for example, more or less homogeneous mixtures of plaster/water, more or less fluid pastes, hardened pastes or finished articles of all forms, properties (including mechanical properties, density and porosity) and intended uses.” NGC914-1006, 1:24-30. Graux further discloses that the composition includes gypsum and that the method includes a “setting” step. NGC914-1006, 1:35-39, 1:55-58. Moreover, Graux discloses mixing the materials, including the additives, for three minutes, and then introducing the mixed composition into a mold so that the composition can set.

NGC914-1006, 9:39-46. A person having ordinary skill in the art would understand that set gypsum necessarily includes an interlocking matrix of set gypsum. In particular, the existence of an “interlocking matrix” of set gypsum is the reason that set gypsum-containing products have been used for centuries. Accordingly, a person having ordinary skill in the art would understand that Graux discloses this claim element.

iii. Claim 1c: the board has been prepared by a method comprising:

107. Graux discloses a method of producing a gypsum board. NGC914-1006, 1:6-9, 1:24-30. Graux states that the composition can include “additives [and] may be carried out by a large number of different ways” NGC914-1006, 8:14-19. In particular, Graux discloses that “[t]he term ‘plaster’ means . . . all building plasters, plasters for special building purposes, plasters for prefabrication and moulding plasters for the arts and industry.” NGC914-1006, 1:6-9. Graux also discloses that this composition is “set” as it discloses “[f]or the preparation of these articles, it is compulsory that the amylaceous compounds have no detrimental influence on the fluidity, the hardening or the setting” of the composition. NGC914-1006, 1:55-58. Graux discloses that the compositions “must be considered . . . in the form of finished articles of all forms, properties . . . and intended uses,” which necessarily includes prefabricated products like gypsum board. NGC914-1006, 1:24-30. Graux further discloses that compositions

produced by this method include gypsum. NGC914-1006, 1:35-39. Graux discloses that the gypsum included in the composition can take several forms: “[t]he origin, nature and concentration of any form of calcium sulphate contained in the plaster (dihydrate form gypsum, hydrated forms, particularly hemihydrates, calcined/rehydrated forms, anhydrous forms, . . .) are in no way limiting within the context of the present invention.” NGC914-1006, 1:35-39. Accordingly, a person having ordinary skill in the art would understand that Graux discloses this claim element.

- iv. **Claim 1d: forming or depositing a mixture between the cover sheets, wherein the mixture comprises a calcined gypsum, water, an accelerator, and one or more enhancing materials selected from the group consisting of: sodium trimetaphosphate, tetrapotassium pyrophosphate, tetrasodium pyrophosphate, aluminum trimetaphosphate, sodium acid pyrophosphate, ammonium polyphosphate having 1000-3000 repeating phosphate units, and acids, salts, or the anionic portions thereof, and,**

108. The step of “forming or depositing” a gypsum-containing slurry “between cover sheets” is implemented in all gypsum board manufacturing methods. Indeed, a person having ordinary skill in the art would understand that a gypsum-containing slurry, which includes any additives such as STMP, flows out onto paper and is topped off with another sheet of paper during the manufacturing process. Accordingly, this claim limitation would have been obvious in light of the knowledge of a person having ordinary skill in the art.

109. Moreover, the specification of the '914 patent discloses this as it discloses Summerfield, which is directed to manufacturing plasterboard from gypsum. NGC914-1017, 1:13-35; NGC914-1003, 9:19-27. Summerfield discloses the basic method of manufacturing plasterboard as it states that

[A]n aqueous slurry of calcined gypsum is continuously deposited on a moving sheet of paper which constitutes one cover for the final product. The slurry so deposited is leveled by a roller and a second cover sheet is simultaneously applied and one of the cover sheets may be folded over the edge of the unset slurry. The gypsum forming the core between the opposed sheets is allowed to set and the resulting board is cut to a desired length and passed through a drying kiln in which the excess water is removed.

NGC914-1017, 1:17-30 (emphasis added). A person having ordinary skill in the art would be motivated to combine the teachings of Summerfield with Graux at least because, as stated, Summerfield is disclosed in the '914 patent and because both references are in the same field. Indeed, a person having ordinary skill in the art would be motivated to combine, with a reasonable expectation of success, the disclosure of Summerfield with Graux.

110. Graux further discloses that this mixture is created by mixing “any form of calcium sulphate” including “dihydrate form gypsum, . . . calcined/rehydrated forms,” NGC914-1006, 1: 35-39, with “an equal weight of water,” NGC914-1006, 9:29-30, various “additives” including “accelerators such

as, . . . , gypsum, potassium sulphate, lime,” NGC914-1006, 7:32-33, and “cationic potato starch . . . , crosslinked with sodium trimetaphosphate.” NGC914-1006, 10:29-30. Accordingly, a person having ordinary skill in the art would understand that Graux discloses this claim element and, further, that Graux discloses STMP.

111. It is sufficient that Graux discloses STMP; however, Graux specifically discloses STMP as an enhancing material. As stated, Graux discloses that starch is “crosslinked with sodium trimetaphosphate.” NGC914-1006, 10:29-30.

Enhancing materials are additives that improve at least one of resistance to permanent deformation, strength, and dimensional stability in set gypsum-containing products, with such enhancing materials including STMP. A person having ordinary skill in the art would understand that crosslinking is at least one indicator that STMP is being used as an enhancing material, e.g., for improving at least one of resistance to permanent deformation, strength, and dimensional stability. Graux teaches that in a predominantly gypsum matrix, there is an interaction between gypsum, starch, and/or STMP that improves the quality of the gypsum product.

v. Claim 1e: maintaining the mixture under conditions sufficient for the calcined gypsum to form the interlocking matrix of set gypsum,

112. As stated, Graux discloses a method of producing a composition of set gypsum like gypsum board. NGC914-1006, 1:6-9, 1:24-30. Indeed, Graux

discloses that the “compositions according to the invention must be considered both in the form of powders, these being ready to use or otherwise, and in the form of, for example, more or less homogeneous mixtures of plaster/water, more or less fluid pastes, hardened pastes or finished articles of all forms, properties (including mechanical properties, density and porosity) and intended uses.” NGC914-1006, 1:24-30. As also stated, Graux discloses that the composition includes gypsum and that the method includes a “setting” step. NGC914-1006, 1:35-39, 1:55-58. Moreover, Graux discloses mixing the materials, including the additives, for three minutes, and then introducing the mixed composition into a mold so that the composition can set. NGC914-1006, 9:39-46. A person having ordinary skill in the art would understand that set gypsum necessarily includes an interlocking matrix of set gypsum. In particular, the existence of an “interlocking matrix” of set gypsum is the reason that set gypsum-containing products have been used for centuries. Accordingly, a person having ordinary skill in the art would understand that Graux discloses this claim element.

- vi. Claim 1f: the enhancing material or materials having been included in the mixture in an amount such that the gypsum board has greater sag resistance than it would have if the enhancing material had not been included in the mixture, said board having a sag resistance as determined according to ASTM C473-95 of less than about 0.1 inch per two foot length of said board**

113. As stated with respect to Claim 1b, Graux discloses the inclusion of

enhancing materials in the composition, including water, NGC914-1006, 9:29-30, “additives” including “accelerators such as, . . . , gypsum, potassium sulphate, lime,” NGC914-1006, 7:32-33, and STMP, as the reference discloses “cationic potato starch . . . , crosslinked with sodium trimetaphosphate,” NGC914-1006, 10:29-30. A person having ordinary skill in the art would understand that adding an “enhancing material” to the mixture would provide better resistance to deformation than if it was not added. However, a person having ordinary skill in the art would also understand that there is no standard amount of “enhancing material” to add to the mixture for forming a set gypsum-containing product. A person having ordinary skill in the art, understanding that the prior art discloses the inclusion of enhancing materials in a set gypsum-containing product, would find it obvious to include the enhancing materials in the mixture in amounts that provide for increased sag resistance and would have a reasonable expectation of success in doing so.

114. ASTM C473-95 teaches a method of testing for sag resistance (entitled “Humidified Deflection”). A person having ordinary skill in the art, understanding the similarities between ASTM C473-95, which teaches a test method for determining sag resistance, NGC914-1009, at ¶ 49, and Graux, would find it obvious to use ASTM C473-95, to test the sag resistance of the set gypsum-containing products of Graux and would have a reasonable expectation of success

in doing so.

115. A person having ordinary skill in the art would understand that STMP was known in the art as improving the quality of set gypsum-containing products. Further, a person having ordinary skill in the art would understand that ASTM C473-95 measures one such quality, *i.e.* sag resistance. As a result, this limitation is simply stating an inherent property of an already-known composition. Accordingly, a person having ordinary skill in the art would understand that the combination of Graux and ASTM C473-95 discloses this claim element.

116. Moreover, as shown in FIGS. 2 and 3 of the '914 patent, set gypsum-containing products having sag of less than 0.1 inch were known in the art prior to the priority date of the '914 patent. For example, FIGS. 2 and 3 of the '914 patent illustrate the National Gypsum Company Gold Bond® High Strength Ceiling Board as having a sag resistance of .075 inches after 48 hours of testing, the same length of testing prescribed by ASTM C473-95. In this regard, the National Gypsum Company Gold Bond® High Strength Ceiling Board achieved improved sag resistance even better than the 0.1 inch requirement established by the '914 patent. Although the tests performed to provide the results illustrated in FIGS. 2 and 3 were not conducted in accordance with ASTM C473-95, it is my opinion that the tests used to produce the results illustrated in FIGS. 2 and 3 were conducted in harsher testing conditions that would cause more sag in the tested set gypsum-

containing products due to the added weight from insulation and the potential for humidity to condense within the board core, as it does in real high humidity installations. NGC914-1038, 16:21-33. In this regard, the '914 patent identifies that boards already existed that satisfied this limitation. All the claim requires is satisfying this condition that had already been met by existing boards without explaining how this condition would be achieved. Therefore, the claim presumes that a person having ordinary skill in the art would understand how to create a ½ inch thick set gypsum-containing product that could meet the specified ASTM standard.

vii. Claim 1g: the accelerator having been included in an amount such that the gypsum board has greater strength than it would have if the accelerator had not been included in the mixture.

117. As stated, Graux discloses the inclusion of enhancing materials in the composition, including water, NGC914-1006, 9:29-30, “additives” including “accelerators such as, . . . , gypsum, potassium sulphate, lime,” NGC914-1006, 7:32-33, and “cationic potato starch . . . , crosslinked with sodium trimetaphosphate,” NGC914-1006, 10:29-30. Accelerators are added to accelerate hardening of the gypsum-containing product. Indeed, a person having ordinary skill in the art would understand that adding an accelerator to the mixture would provide improved strength to set gypsum-containing products over those to which it was not added by altering the rate of crystal growth so that the crystals more

quickly reach an optimal size such that gypsum-containing products are stronger at the time they are cut. However, a person having ordinary skill in the art would also understand that there is no standard amount of accelerator to add to the mixture for forming a set gypsum-containing product. Indeed, the amount of accelerator added to the mixture varies from day-to-day and plant-to-plant depending on various factors including temperature, production rates, etc. A person having ordinary skill in the art, understanding that the prior art discloses the inclusion of an accelerator in a set gypsum-containing product, would find it obvious to include the accelerator in the mixture in an amount that provides for increased strength and would have a reasonable expectation of success in doing so.

118. Moreover, Hjelmeland teaches that accelerators “accelerate the hardening process.” NGC914-1008, Abstract. Because Hjelmeland and Graux are in the very same field (*i.e.* set gypsum-containing products) as previously discussed, a person having ordinary skill in the art would understand that the descriptions of accelerators disclosed by Hjelmeland also apply to the accelerators of Graux. Accordingly, a person having ordinary skill in the art would understand that a combination of Graux and Hjelmeland discloses this claim element.

viii. Claim 2: The gypsum board of claim 1, wherein the concentration of the enhancing material in the mixture is from 0.004 to 2.0 percent by weight, based on the weight of the calcined gypsum.

119. As stated, Graux discloses using “cationic potato starch . . . ,

crosslinked with sodium trimetaphosphate” in making the disclosed set gypsum board. NGC914-1006, 10:29-30. Hjelmeland discloses a set gypsum-containing product, which includes “a set retarding substance comprising (i) an organic acid containing at least two acid groups selected from the group consisting of . . . phosphate or phosphonate . . . and/or (ii) inorganic anions selected from the group consisting of polyphosphate” NGC914-1008, 3:60-4:2. Hjelmeland further discloses that “the set retarding substance constitutes . . . 0.01-0.2% . . . by weight of the gross water quantity in the first component.” NGC914-1008, 4:13-15. Accordingly, person having ordinary skill in the art would further understand that Hjelmeland discloses the addition of the “set retarding substance” in the claimed range. Further, a person having ordinary skill in the art would understand that the “set retarding substance” of Hjelmeland is STMP.

120. Although Hjelmeland discloses STMP as a “set retarding substance,” a person having ordinary skill in the art would understand that, as with many reagents, the accelerating and retarding effects of STMP vary based on pH. Indeed, a person having ordinary skill in the art would understand that at a high pH STMP acts as a retarder, and at a lower pH STMP acts as an accelerator. A person having ordinary skill in the art would also understand that Hjelmeland is primarily directed to the use of plaster, which has a high pH. As such, a person having ordinary skill in the art would understand that because the plaster is at a

high pH, STMP will act as a retarder. Moreover, a person having ordinary skill in the art would understand that Hjelmeland uses the term “set retarding substance” to refer to STMP’s ability to extend the induction time of gypsum, which delays the time at which the gypsum begins to set and, as such, allows the gypsum to be manipulated without subjecting growing crystals to shear. Indeed, STMP increases the core strength of the set gypsum-containing product because it allows a greater proportion of crystals to grow undisturbed. In this regard, a person having ordinary skill in the art would understand that Hjelmeland teaches an interaction between STMP and gypsum that results in a product with at least increased core strength.

121. A person having ordinary skill in the art would understand that the water quantity in Hjelmeland can be equated with the calcined gypsum quantity in Hjelmeland. In particular, for the applications described by Hjelmeland, a person having ordinary skill in the art would understand that a water/stucco ratio of 0.66 is used. As such, although Hjelmeland discloses that “the set retarding substance constitutes . . . 0.01-0.2% . . . by weight of the gross water quantity in the first component,” NGC914-1008, 4:13-15, this range equates to an amount of enhancing material of 0.0066-0.132% by weight of the calcined gypsum. Moreover, Examples 15 and 16 of Hjelmeland teach the use of an amount enhancing material of 0.033% by weight of the calcined gypsum. NGC914-1008,

12:24-26, 12:48-50.

122. A person having ordinary skill in the art would understand that the set retarding substance of Hjelmeland is a condensed phosphoric acid or ion of a condensed phosphate. Moreover, a person having ordinary skill in the art would understand that STMP, as disclosed by Graux, is a salt of a condensed phosphate. As such, a person having ordinary skill in the art, understanding the similarities between Hjelmeland, which discloses the amount of condensed phosphoric acid or ion of condensed phosphate to include in a set gypsum-containing product, NGC914-1008, 4:13-15, and Graux, would find it obvious to use approximately the amount of condensed phosphate specified by Hjelmeland in the plaster compositions of Graux and would have a reasonable expectation of success in doing so. I understand from counsel that when the prior art discloses a range that falls within the claimed range, the claimed range is obvious over the prior art. Accordingly, a person having ordinary skill in the art would understand that the combination of Graux and Hjelmeland discloses this claim element.

123. In addition, a person having ordinary skill in the art would find a range of “enhancing material” from 0.004% to 2.0% by weight to be extremely broad. Indeed, 0.004% of an “enhancing material” is significantly less than necessary, while 2.0% is significantly more than necessary. As such, a person having ordinary skill in the art would not consider this range to be a true limitation of the

claim.

- ix. **Claim 3: The gypsum board of claim 1, wherein the calcined gypsum comprises one or more of: calcium sulfate anhydrite; calcium sulfate hemihydrate; or ions of calcium and sulfate.**

124. As stated, Graux discloses a set gypsum-containing product including “any form of calcium sulphate” including “dihydrate form gypsum, hydrated forms, particularly hemihydrates, calcined/rehydrated forms, anhydrous forms, . . .” NGC914-1006, 1:35-39. Accordingly, a person having ordinary skill in the art would understand that Graux discloses this claim element.

- x. **Claim 4: The gypsum board of claim 1, wherein the enhancing material comprises one or more of the following salts, or the anionic portions thereof: sodium trimetaphosphate and ammonium polyphosphate having 1000-3000 repeating phosphate units**

125. As stated, Graux specifically discloses STMP as it describes using “cationic potato starch . . . , crosslinked with sodium trimetaphosphate” in making the disclosed composition of set gypsum. NGC914-1006, 10:29-30. Accordingly, a person having ordinary skill in the art would understand that Graux discloses this claim element.

126. Further, as stated, Graux specifically discloses STMP as an enhancing material. As stated, Graux discloses that starch is “crosslinked with sodium trimetaphosphate.” NGC914-1006, 10:29-30. A person having ordinary skill in the art would understand that crosslinking is at least one indicator that STMP is

being used as an enhancing material, e.g., for improving at least one of resistance to permanent deformation, strength, and dimensional stability. *Id.* Graux teaches that in a predominantly gypsum matrix, there is an interaction between gypsum, starch, and/or STMP that improves the quality of the gypsum product. *Id.*

xi. Claim 6: The gypsum board of claim 1, wherein the mixture further comprises a pregelatinized starch.

127. As stated, Graux discloses that the “amylaceous compound” disclosed “may, before, at the same time as or after the cationization stage, undergo a physical treatment or several physical treatments, which may or not be performed simultaneously” including “drum gelatinisation.” NGC914-1006, 6:17-44. Graux further states that it discloses a composition which contains a “cationic amylaceous compound[] that [has] been . . . gelatinized in a drum . . .”. NGC914-1006, 6:17-44. A person having ordinary skill in the art, therefore, would understand that Graux discloses pregelatinized starch as it discloses that the amylaceous compound can be gelatinized in a drum before the cationization stage and before the gypsum-containing product sets.

128. Additionally in its background discussion of useful prior art references, Graux cites EP 117 431, which is directed to improve water-retaining properties of starches mixed with gypsum, for the proposition that pregelatinized starch is used in set gypsum-containing products because it is an advantageous water retaining agent. In particular, Graux states that the patent “underlines the advantage, as

water retaining agents for plaster-based mixtures, of combinations of . . . particular amylaceous compounds, namely pregelatinised hydroxyalkyl, particularly hydroxyethyl or hydroxypropyl starches.” NGC914-1006, 2:6-11. Accordingly, a person having ordinary skill in the art would understand that this claim limitation has been met.

129. Moreover and as previously discussed, a person having ordinary skill in the art would understand that either pregelatinized starch or other non-pregelatinized starches may be used in set gypsum-containing products. Indeed, using pregelatinized starch allows, in many cases, less overall starch to be used in the production of set gypsum-containing products because pregelatinized starch has a higher ability to absorb water than other starches. In this regard, pregelatinized starch provides certain beneficial properties including improved mix rheology, bubble structure, and dry strength. However, similar outcomes can be achieved by adding more volume of other non-pregelatinized starches. Accordingly, the use of pregelatinized starch was a known alternative to other starches to a person having ordinary skill in the art.

xii. Claim 8: The gypsum board of claim 1, wherein: the core has voids uniformly distributed therein; and the mixture further comprises an aqueous foam.

130. The specification of the '914 patent discloses U.S. Pat. No. 5,643,510 to Sucech, which discloses the use of foaming agents in order to “produce[] a

multiplicity of large voids *substantially uniformly distributed* throughout the foamed gypsum core.” NGC914-1036, 5:12-14 (emphasis added); NGC914-1038, 9:53-62. Moreover, the specification states that

In embodiments of the invention that employ a foaming agent to yield voids in the set gypsum-containing product to provide lighter weight, any of the conventional foaming agents known to be useful in preparing foamed set gypsum products can be employed. . . . For further descriptions of useful foaming agents, see, for example: U.S. Pat. Nos. . . . 5,643,510 . . .

NGC914-1038, 9:53-62 (citing NGC914-1036).

131. As stated, a person having ordinary skill in the art, understanding the similarities between Sucech, which discloses the use of foaming agents in production of set gypsum-containing products to lower their weight and density, NGC914-1036, 1:30-35, 5:12-14, and Graux, would find it obvious to add a foaming agent as taught by Sucech to the set gypsum-containing products of Graux and would have a reasonable expectation of success in doing so. Indeed, a person having ordinary skill in the art would understand that foaming agents are necessarily used in set gypsum-containing products in order to reduce the density of the products, increase ease of handling, increase thermal insulation and sound proofing, decrease drying time, reduce brittleness of the product, and decrease the use of raw gypsum. A person having ordinary skill in the art would understand

that foaming agents are used to control the density of the board, which, in turn, helps provide strength to the gypsum board while lowering its weight and bulk density.

xiii. Claim 10: The gypsum board of claim 1, wherein the mixture further comprises a pregelatinized starch and an aqueous foam.

132. As stated, Graux discloses that the “amylaceous compound” disclosed “may, before, at the same time as or after the cationization stage, undergo a physical treatment or several physical treatments, which may or not be performed simultaneously” including “drum gelatinisation.” NGC914-1006, 6:17-44. Graux further states that it discloses a composition which contains a “cationic amylaceous compound[] that [has] been . . . gelatinized in a drum . . .”. NGC914-1006, 6:17-44. A person having ordinary skill in the art, therefore, would understand that Graux discloses pregelatinized starch as it discloses that the amylaceous compound can be gelatinized in a drum before the cationization stage and before the gypsum-containing product sets.

133. Additionally in its background discussion of useful prior art references, Graux cites EP 117 431, which is directed to improve water-retaining properties of starches mixed with gypsum, for the proposition that pregelatinized starch is used in set gypsum-containing products because it is an advantageous water retaining agent. In particular, Graux states that the patent “underlines the advantage, as

water retaining agents for plaster-based mixtures, of combinations of . . . particular amylaceous compounds, namely pregelatinised hydroxyalkyl, particularly hydroxyethyl or hydroxypropyl starches.” NGC914-1006, 2:6-11. Accordingly, a person having ordinary skill in the art would understand that this claim limitation has been met.

134. Moreover and as previously discussed, a person having ordinary skill in the art would understand that either pregelatinized starch or other non-pregelatinized starches may be used in set gypsum-containing products. Indeed, using pregelatinized starch allows, in many cases, less overall starch to be used in the production of set gypsum-containing products because pregelatinized starch has a higher ability to absorb water than other starches. In this regard, pregelatinized starch provides certain beneficial properties including improved mix rheology, bubble structure, and dry strength. However, similar outcomes can be achieved by adding more volume of other non-pregelatinized starches. Accordingly, the use of pregelatinized starch was a known alternative to other starches to a person having ordinary skill in the art

135. The specification of the '914 patent discloses U.S. Pat. No. 5,643,510 to Sucech, which discloses the use of foaming agents in order to “produce[] a multiplicity of large voids *substantially uniformly distributed* throughout the foamed gypsum core.” NGC914-1036, 5:12-14 (emphasis added); NGC914-1038,

9:53-62. Moreover, the specification states that

In embodiments of the invention that employ a foaming agent to yield voids in the set gypsum-containing product to provide lighter weight, any of the conventional foaming agents known to be useful in preparing foamed set gypsum products can be employed. . . . For further descriptions of useful foaming agents, see, for example: U.S. Pat. Nos. . . . 5,643,510 . . .

NGC914-1038, 9:53-62 (citing NGC914-1036).

136. Indeed, a person having ordinary skill in the art would understand that foaming agents are necessarily used in set gypsum-containing products in order to reduce the density of the products, increase ease of handling, increase thermal insulation and sound proofing, decrease drying time, and decrease the use of raw gypsum. As stated, a person having ordinary skill in the art, understanding the similarities between Sucech, which discloses the use of foaming agents in production of set gypsum-containing products to lower their weight and bulk density, NGC914-1036, 1:30-35, 5:12-14, and Graux, would find it obvious to add a foaming agent as taught by Sucech to the set gypsum-containing products of Graux and would have a reasonable expectation of success in doing so.

IX. GROUND 2: OBVIOUSNESS OF CLAIMS 1-4, 6, 8, AND 10 BASED ON SATTERTHWAITE IN VIEW OF HJELMELAND, ASTM C473-95, SUCECH AND SUMMERFIELD

137. Satterthwaite teaches the ingredients of the set gypsum-containing product described in the claims, including calcined gypsum, water, starch, and one

or more enhancing materials. The additional elements recited in the claims merely disclose the natural consequence of combining those ingredients. However, those additional natural consequences are further described in Hjelmeland and ASTM C473-95. Hjelmeland discloses including the one or more enhancing materials in an amount of “0.01-0.2% by weight.” NGC914-1008, 4:11-15. ASTM C473-95 discloses test methods for determining various properties of gypsum products, including humidified deflection (*i.e.* sag resistance). NGC914-1009, at ¶ 49. Sucech, Baig, and Summerfield are only being used for certain claims that recite specific elements that USG admits existed in the prior art in the specification of the ’941 patent. The chart below shows the combinations of references being used to invalidate each claim element.

Claim Limitation	Reference
1a	Satterthwaite
1b	Satterthwaite, Summerfield
1c	Satterthwaite
1d	Satterthwaite, Summerfield
1e	Satterthwaite
1f	Satterthwaite, ASTM
1g	Satterthwaite, Hjelmeland
2	Satterthwaite, Hjelmeland
3	Satterthwaite
4	Satterthwaite
6	Satterthwaite
8	Satterthwaite, Sucech
10	Satterthwaite, Sucech

A. Satterthwaite

138. U.S. Patent No. 3,234,037 to Satterthwaite (“Satterthwaite”) was filed

on September 28, 1961, and issued on February 8, 1966. Satterthwaite was not before the Examiner during prosecution of the '914 patent.

139. Satterthwaite is also directed to set gypsum-containing products, in particular tile products such as acoustical ceiling tiles. NGC914-1007, 1:13-23. In fact, the specification of the '914 patent specifically indicates that, as early as 1966, it was known in the art that acoustical ceiling tiles could be made using rehydrated calcium sulfate hemihydrate, *i.e.* set gypsum. NGC914-1038, 1:61-66; *see also*, NGC914-1027. Satterthwaite discloses “the production of a starch binder comprising a thick-boiling starch and a polyhydric alcohol fatty acid ester.” NGC914-1007, 1:11-12.

140. The starch binder disclosed by Satterthwaite includes a starch treated with STMP, NGC914-1007, 2:9-11, “for use in the manufacture of acoustical ceiling tile and other tile products made from a mixture of water, gypsum, mineral wool and other ingredients.” NGC914-1007, 1:15-18. The mixture including the starch binder is “formed into sheets . . . cut into sections, dried in an oven, cooled, cut, and processed for sale.” NGC914-1007, 3:41-42.

141. Satterthwaite states that while thick-boiling starches are “commonly used as binders in the tile making process,” NGC914-1007, 1:24-25, existing methods of making thick-boiling starches are “time-consuming and expensive because of the high percentage of partially dried tile . . . obtained after the usual

drying operation.” NGC914-1007, 1:40-42. Thus, the stated object of Satterthwaite is to provide a “faster drying rate . . .[,] elimination of sub-standard tile . . .[,] increased wet strength, increased density and increased resistance to warp or sag.” NGC914-1007, 1:58-62. A person having ordinary skill in the art would understand that the increased wet strength achieved by Satterthwaite is only possible due to the crosslinking of the starch with, for example, STMP. *See* NGC914-1007, 2:9-13.

B. ASTM C473-95

142. ASTM C473-95 entitled *Standard Test Methods for Physical Testing of Gypsum Board Products and Gypsum Lath* was the testing standard for gypsum products in 1995, although the same tests as those provided by ASTM C473-95 were used at least as early as 1981, NGC914-1031, and some version of ASTM C473 existed as early as 1961. NGC914-1009, 1, n.1. Moreover, the ’914 patent repeatedly identifies ASTM C473-95 as being the known testing standard at the time the ’914 patent was filed. *See, e.g.*, NGC914-1035, 18:59-67.

143. ASTM C473-95 provides test methods for measuring various characteristics of gypsum products, including humidified deflection (*i.e.* sag resistance), hardness, and nail pull resistance. NGC914-1009. As previously discussed, the humidified deflection test is used to “evaluat[e] the deflection of gypsum board or gypsum lath when horizontally suspended and subjected to high

humidity.” NGC914-1009, at ¶ 49. Additionally, the hardness test is used for “evaluating the relative ability of gypsum board or gypsum lath core, ends, and edges to resist crushing during handling or use of the material.” NGC914-1009, at ¶ 9. Further, the nail pull resistance test is used for “evaluating the ability of gypsum board or gypsum lath to resist nail pull-through by determining the load required to force a standard nailhead through the board or lath.” NGC914-1009, at ¶ 18.

C. Hjelmeland

144. U.S. Patent No. 5,980,628 to Hjelmeland et al. (“Hjelmeland”) claims priority to PCT Application No. PCT/NO96/00116 filed May 14, 1996 and published December 5, 1996. Hjelmeland was not before the Examiner during prosecution of the ’914 patent.

145. Hjelmeland is directed to set gypsum-containing products. NGC914-1008, 1:6-7. Hjelmeland states that existing set gypsum-containing products either “creep” after application or harden “in mixer units and pumps and lead to clogging or blocking of the equipment.” NGC914-1008, 1:22-31. Thus, the stated object of Hjelmeland is to teach “a curable gypsum-based composition for the production of cured gypsum, enabling an efficient use of gypsum as material in . . . building constructions.” NGC914-1008, 3:16-19.

146. The set gypsum-containing product disclosed by Hjelmeland includes

“a set retarding substance comprising (i) an organic acid containing at least two acid groups selected from the group consisting of . . . phosphate or phosphonate . . . and/or (ii) inorganic anions selected from the group consisting of polyphosphate” NGC914-1008, 3:60-4:2. Hjelmeland further discloses that “the set retarding substance constitutes . . . 0.01-0.2% . . . by weight of the gross water quantity in the first component.” NGC914-1008, 4:13-15. Accordingly, a person having ordinary skill in the art would further understand that Hjelmeland discloses the addition of the “set retarding substance” in the claimed range. Further, a person having ordinary skill in the art would understand that the “set retarding substance” of Hjelmeland includes STMP.

147. Although Hjelmeland discloses STMP as a “set retarding substance,” a person having ordinary skill in the art would understand that, as with many reagents, the accelerating and retarding effects of STMP vary based on pH. Indeed, a person having ordinary skill in the art would understand that at a high pH STMP acts as a retarder, and at a lower pH STMP acts as an accelerator. A person having ordinary skill in the art would also understand that Hjelmeland is primarily directed to the use of plaster, which has a high pH. As such, a person having ordinary skill in the art would understand that because the plaster is at a high pH, STMP acts as a retarder. Moreover, a person having ordinary skill in the art would understand that Hjelmeland uses the term “set retarding substance” to refer to

STMP's ability to extend the induction time of gypsum, which delays the time at which the gypsum begins to set and, as such, allows the gypsum to be manipulated without subjecting growing crystals to shear. Indeed, STMP increases the core strength of the set gypsum-containing product because it allows a greater proportion of crystals to grow undisturbed. In this regard, a person having ordinary skill in the art would understand that Hjelmeland teaches an interaction between STMP and gypsum that results in a product with at least increased core strength.

D. Sucech

148. U.S. Patent No. 5,643,510 to Sucech ("Sucech") was filed on February 8, 1996, and issued on July 1, 1997. NGC914-1036. Sucech was disclosed to the PTO during the prosecution of the '914 patent, but was not cited in an Office Action or referred to during prosecution. Sucech is directed to a "process and foaming system for producing foamed gypsum board which permits the production and control of large foam voids in the gypsum core by adjusting the ratio of a first foaming agent and a second foaming agent" in order to develop lighter board. NGC914-1036, Abstract. Sucech teaches processes for incorporating foaming agents into the gypsum mixtures. NGC914-1036, 2:26-29.

E. Summerfield

149. U.S. Patent No. 2,985,219 to Summerfield ("Summerfield") was filed

on December 29, 1958, and issued on May 23, 1961. NGC914-1017.

Summerfield states that one object of the invention is to disclose “a process and apparatus for making plasterboard which is readily adaptable to present day commercial machines and methods.” NGC914-1017, 3:33-37. Summerfield further discloses the basic process for making gypsum boards, which include mixing a gypsum-containing slurry, depositing the slurry onto a sheet of paper, covering the slurry with another sheet of paper, allowing the slurry to set, cutting the slurry into the desired size, and drying the slurry in a kiln. NGC914-1017, 1:17-30.

F. Motivation to Combine Satterthwaite, ASTM C473-95, Hjelmeland, Sucech, and Summerfield

150. The '914 patent essentially emphasizes three points relevant to gypsum containing products. First, the specification notes there is a “continuing effort” to make set gypsum products lighter, and notes that the natural consequence of that is a need to increase the strength of the product beyond normal levels to increase overall strength. NGC914-1038, 2:27-35. Second, the specification notes that under high humidity conditions, there is a need for greater sag resistance. NGC914-1038, 2:45-50. Third, the specification describes a need for greater dimensional stability to limit shrinking or expanding of the product, particularly under conditions of changing temperature and humidity. NGC914-1038, 2:57-61. The '914 patent purports to solve at least one of these issues through the use of

allegedly novel gypsum compositions that incorporate certain “enhancing materials” to reduce sag. However, the enhancing material of the claims of the ’914 patent does not appear to be directed to improving the dimensional stability of the set gypsum product.

151. As introduced above and described in greater detail below, Satterthwaite discloses a set gypsum-containing product with the ingredients identified in the claimed composition except an accelerator. In particular, Satterthwaite discloses a starch treated with STMP, NGC914-1007, 2:9-11, “for use in the manufacture of acoustical ceiling tile and other tile products made from a mixture of water, gypsum, mineral wool and other ingredients.” NGC914-1007, 1:15-18. Hjelmeland also teaches the inclusion of accelerators that “accelerate the hardening process.” NGC914-1008, Abstract. A person having ordinary skill in the art would know that the additional ingredients of accelerators and STMP are added for a reason. Indeed, in my experience in the industrial manufacture of gypsum containing products, any additional ingredient that was added to the composition was done for the specific purpose of improving some characteristic of the product. In the case of accelerators, those were added to, among other things, increase strength. Enhancing materials were included to, among other things, increase sag resistance. A person having ordinary skill in the art would also understand that Satterthwaite’s disclosure of a slurry formed into acoustical tiles is

equally applicable to other set gypsum-containing products including gypsum boards. Indeed, the specification of the '914 patent states that “[t]he invention relates to a method and composition for preparing set gypsum-containing products, e.g., gypsum boards, reinforced gypsum composite boards, plasters, machinable materials, joint treatment materials, and acoustical tiles...” NGC914-1038, 1:25-30. The specification further states that it relates to “products [that] contain set gypsum (calcium sulfate dihydrate)” to include “paper-faced gypsum boards,” “gypsum/cellulose fiber composite boards,” “[p]roducts that fill and smooth the joints between edges of gypsum boards,” “[a]coustical tiles useful in suspended ceilings,” and “[t]raditional plasters.” NGC914-1038, 1:56-2:8.

152. I agree with the notion presented in the specification of the '914 patent that at that time there was a “continuing effort” to make products lighter, which in turn required greater strength. At least as early as the 1990s, the gypsum product industry was focused on making lighter products to limit freight costs and create products that were easier to install. I also agree that sag resistance and dimensional stability were also concerns at the time, as these have always been the problems that result when set gypsum-containing products come into contact with water and/or humidity.

153. A person having ordinary skill in the art would also have been very experienced and knowledgeable about ASTM C473-95 and similar testing methods

and would have known the specific tests for testing strength, sag resistance, and dimensional stability. *See, e.g.*, NGC914-1014, and NGC914-1009. In particular, in light of these ASTM tests specifying the characteristics that are indicative of a quality gypsum product, a person having ordinary skill in the art would have been motivated to utilize the known enhancing materials disclosed in Satterthwaite and the accelerators disclosed by Hjelmeland and the '914 patent. In other words, it would have been obvious for a person having ordinary skill in the art to at least try the predictable solutions described in Satterthwaite, and there would have been a reasonable expectation that those ingredients would have yielded a product that provided the required sag resistance described in the claim.

154. The obviousness of the combination and predictable outcome is heightened in this case because Satterthwaite and ASTM C473-95 are in the very same field. In particular, both references relate to gypsum products, with Satterthwaite being directed to set gypsum-containing products having enhancing materials for improving sag resistance, and ASTM C473-95 being directed to measuring the sag resistance of such products. Moreover, as noted above, the '914 patent repeatedly identifies ASTM C473-95 as being the known testing standard at the time the '914 patent was filed. NGC914-1038, 18:59-67. As such, a person having ordinary skill in the art, understanding the similarities between ASTM C473-95 and Satterthwaite, would find it obvious to use ASTM C473-95 to test the

sag resistance of the set gypsum-containing tile products of Satterthwaite and would have a reasonable expectation of success in doing so.

155. Still further, Hjelmeland discloses a set gypsum-containing product including “a first component comprising calcined gypsum suspended in water, and a set retarding substance comprising . . . inorganic anions selected from the group consisting of polyphosphate and polyborate, or mixtures thereof,” NGC914-1008, 3:60-4:3, and containing the set retarding substance in an amount of “0.01-0.2% by weight of the gross water quantity in the first component.” NGC914-1008, 4:13-

15. A person having ordinary skill in the art would understand that the set retarding substance of Hjelmeland is a condensed phosphoric acid or ion of a condensed phosphate. Moreover, a person having ordinary skill in the art would understand that STMP, as disclosed by Satterthwaite, is a salt of a condensed phosphate. As such, a person having ordinary skill in the art, understanding the similarities between Hjelmeland, which discloses the amount of condensed phosphoric acid or ion of condensed phosphate to include in a set gypsum-containing product, NGC914-1008, 4:13-15, and Satterthwaite, would find it obvious to use the amount of condensed phosphate specified by Hjelmeland in the set gypsum-containing tile products of Satterthwaite because both references disclose a recipe for gypsum-containing product that includes STMP in order to achieve certain beneficial properties. Furthermore, a person having ordinary skill

in the art and would have a reasonable expectation of success in combining the references.

156. Moreover, Sucech, which is cited in the specification of the '914 patent, discloses the use of foaming agents in order to “produce[] a multiplicity of large voids substantially uniformly distributed throughout the foamed gypsum core” in set gypsum-containing products. NGC914-1036, 5:12-14. Indeed, a person having ordinary skill in the art would understand that foaming agents are commonly used in set gypsum-containing products in order to control the density of the products, which, in turn, helps provide strength to the set gypsum-containing products while lowering their weight and bulk density. As such, a person having ordinary skill in the art, understanding the similarities between Sucech, which discloses the use of foaming agents in production of set gypsum-containing products to lower their weight and density, NGC914-1036, 1:30-35, 5:12-14, and Satterthwaite, would find it obvious to add a foaming agent as taught by Sucech to the set gypsum-containing products of Satterthwaite and would have a reasonable expectation of success in doing so. Indeed, this is precisely what Patent Owner did in the specification of the '914 patent when it pointed to Sucech as evidence that “[m]any such foaming agents are well known and readily commercially available.” NGC914-1038, 10:52-63.

157. Moreover, Summerfield, which is discussed in the specification of the

'914 patent, discloses the basic process for manufacturing set gypsum-containing products, including gypsum board. NGC914-1017, 1:13-35. In particular, Summerfield discloses a gypsum-containing slurry that flows out onto paper and is topped off with another sheet of paper. NGC914-1017, 1:17-30. As such, a person having ordinary skill in the art, understanding the similarities between Summerfield, which discloses the basic process of manufacturing gypsum board, NGC914-1017, 1:13-35, and Satterthwaite, would find it obvious to manufacture the set gypsum-containing products of Satterthwaite with paper coverings as taught by Summerfield and would have a reasonable expectation of success in doing so. Indeed, in the specification of the '914 patent, Patent Owner repeatedly cites to Summerfield to demonstrate that "set gypsum is the major component of paper-faced gypsum boards employed in typical drywall construction of interior walls and ceilings of buildings." NGC914-1038, 1:55-66.

158. Each of Satterthwaite, ASTM C473-95, Hjelmeland, Sucech, and Summerfield are narrowly and directly related to improvements of certain specific and well-known properties of set gypsum-containing products. In particular, Satterthwaite, ASTM C473-95, Hjelmeland, Sucech, and Summerfield disclose additives or processes for improving the strength, sag resistance, and/or dimensional stability of set gypsum-containing products, including the use of various enhancing materials, foams, host particles, paper coverings and the like.

Given the similarities between the problems to be solved by Satterthwaite, ASTM C473-95, Hjelmeland, Sucech, and Summerfield and the similarities in their solutions, a person having ordinary skill in the art would have a reasonable expectation of success in combining the teachings of ASTM C473-95, Hjelmeland, Sucech, and Summerfield with the teachings of Satterthwaite.

159. Given the similarities between the problem to be solved by Satterthwaite, ASTM C473-95, Hjelmeland, Sucech, and Summerfield, and the similarities in the solution itself, a person having ordinary skill in the art would have a reasonable expectation of success in combining the teachings of ASTM C473-95, Hjelmeland, Sucech, and Summerfield with the teachings of Satterthwaite. A person having ordinary skill in the art would readily reach to the teachings of one or more of these references because they describe the same products and each are directed to improving characteristics that were known as desirable in the industry. This is evidenced by the specification of the '914 patent. When Patent Owner wished to express that certain aspects of its formulation were known, it pointed to related references in the prior art that taught a specific ingredient or element of its disclosed product. Petitioner relies on certain of the same references here. Petitioner also relies on additional references apparently unknown to Patent Owner and the examiner, but combines those in the same way as Patent Owner did for the Sucech, and Summerfield references. Patent Owner's

citation of Sucech, and Summerfield in the specification of the '914 patent, itself, is an admission that the teachings of at least these references were known to persons having ordinary skill in the art, were part of the body of the prior art, and would readily be a component of an obviousness combination. As described further above and below, Petitioner identifies certain additional references that are readily combined in the same way.

160. To the extent any modifications of the features of Satterthwaite, ASTM C473-95, Hjelmeland, Sucech, and Summerfield would have been necessary, such modification would have been well within the skill of the person having ordinary skill in the art as the set gypsum-containing products disclosed by the references are compatible and chemically similar. Indeed, the asserted claims appear to directly support this conclusion to the extent that they do not recite specific amounts, but instead simply require an enhancing material “in an amount such that the gypsum board has greater sag resistance” and an accelerator “in an amount such that the gypsum board has greater strength than it would have if the accelerator had not been included in the mixture.” As such, the claims themselves contemplate that little more than the ingredients would be known, and otherwise expect those amounts to either be readily known or readily determined by a person having ordinary skill in the art.

G. Element-by-Element Analysis

i. Claim 1a: A gypsum board comprising:

161. Satterthwaite discloses the “manufacture of acoustical ceiling tile and other tile products made from a mixture of water, gypsum, mineral wool and other ingredients.” NGC914-1007, 1:16-18. Satterthwaite further discloses that the tile products are gypsum boards and that “the mixture is blended and formed into sheets, [t]he tile is then cut into sections, dried in an oven, cooled, cut, and processed for sale.” NGC914-1007, 3:40-42. Accordingly, a person having ordinary skill in the art would understand that Satterthwaite discloses this claim element.

ii. Claim 1b: a core of material sandwiched between cover sheets, wherein the core comprises an interlocking matrix of set gypsum,

162. All that this claim discloses is the basic preparation of gypsum board: a gypsum-containing slurry is deposited onto a sheet of paper and is covered with another sheet of paper. As the board travels down the line, the gypsum-containing slurry sets and becomes an interlocking matrix. Accordingly, this claim limitation would have been obvious in light of the knowledge of a person having ordinary skill in the art.

163. Moreover, the specification of the '914 patent discloses this as it discloses Summerfield, which is directed to manufacturing plasterboard from

gypsum. NGC914-1017, 1:13-35; NGC914-1003, 9:19-27. Summerfield discloses the basic method of manufacturing plasterboard as it states that

[A]n aqueous slurry of calcined gypsum is continuously deposited on a moving sheet of paper which constitutes one cover for the final product. The slurry so deposited is leveled by a roller and a second cover sheet is simultaneously applied and one of the cover sheets may be folded over the edge of the unset slurry. The gypsum forming the core between the opposed sheets is allowed to set and the resulting board is cut to a desired length and passed through a drying kiln in which the excess water is removed.

NGC914-1017, 1:17-30 (emphasis added). A person having ordinary skill in the art would be motivated to combine the teachings of Summerfield with Satterthwaite at least because, as stated, Summerfield is disclosed in the '914 patent and because both references are in the same field. Indeed, a person having ordinary skill in the art would be motivated to combine, with a reasonable expectation of success, the disclosure of Summerfield with Satterthwaite.

164. Satterthwaite discloses set gypsum-containing products as it is directed to the “manufacture of acoustical ceiling tile and other tile products made from a mixture of water, gypsum, mineral wool and other ingredients.” NGC914-1007, 1:16-18. Satterthwaite further discloses that the tile products are set gypsum-containing products and states that “the mixture is blended and formed into sheets . . . , [t]he tile is then cut into sections, dried in an oven, cooled, cut, and processed

for sale.” NGC914-1007, 3:40-42. A person having ordinary skill in the art would understand that set gypsum necessarily includes an interlocking matrix of set gypsum. In particular, the existence of an “interlocking matrix” of set gypsum is the reason that set gypsum-containing products have been used for centuries. Accordingly, a person having ordinary skill in the art would understand that Satterthwaite discloses this claim element.

iii. Claim 1c: the board has been prepared by a method comprising:

165. Satterthwaite discloses the “manufacture of acoustical ceiling tile and other tile products made from a mixture of water, gypsum, mineral wool and other ingredients.” NGC914-1007, 1:16-18. Satterthwaite further discloses that the tile products are set gypsum-containing products and states that “the mixture is blended and formed into sheets . . . , [t]he tile is then cut into sections, dried in an oven, cooled, cut, and processed for sale.” NGC914-1007, 3:40-42. Accordingly, a person having ordinary skill in the art would understand that Satterthwaite discloses this claim element.

iv. Claim 1d: forming or depositing a mixture between the cover sheets, wherein the mixture comprises a calcined gypsum, water, an accelerator, and one or more enhancing materials selected from the group consisting of: sodium trimetaphosphate, tetrapotassium pyrophosphate, tetrasodium pyrophosphate, aluminum trimetaphosphate, sodium acid pyrophosphate, ammonium polyphosphate having 1000-3000 repeating phosphate units, and acids,

salts, or the anionic portions thereof, and,

166. The step of “forming or depositing” a gypsum-containing slurry “between cover sheets” is implemented in all gypsum board manufacturing methods. Indeed, a person having ordinary skill in the art would understand that a gypsum-containing slurry, which includes any additives such as STMP, flows out onto paper and is topped off with another sheet of paper during the manufacturing process. Accordingly, this claim limitation would have been obvious in light of the knowledge of a person having ordinary skill in the art.

167. Moreover, the specification of the '914 patent discloses this as it discloses Summerfield, which is directed to manufacturing plasterboard from gypsum. NGC914-1017, 1:13-35; NGC914-1003, 9:19-27. Summerfield discloses the basic method of manufacturing plasterboard as it states that

[A]n aqueous slurry of calcined gypsum is continuously deposited on a moving sheet of paper which constitutes one cover for the final product. The slurry so deposited is leveled by a roller and a second cover sheet is simultaneously applied and one of the cover sheets may be folded over the edge of the unset slurry. The gypsum forming the core between the opposed sheets is allowed to set and the resulting board is cut to a desired length and passed through a drying kiln in which the excess water is removed.

NGC914-1017, 1:17-30 (emphasis added). A person having ordinary skill in the art would be motivated to combine the teachings of Summerfield with Satterthwaite at

least because, as stated, Summerfield is disclosed in the '914 patent and because both references are in the same field. Indeed, a person having ordinary skill in the art would be motivated to combine, with a reasonable expectation of success, the disclosure of Summerfield with Satterthwaite.

168. As stated with respect to Claim 1a, Satterthwaite discloses set gypsum-containing products as it is directed to the “manufacture of acoustical ceiling tile and other tile products made from a mixture of water, gypsum, mineral wool and other ingredients.” NGC914-1007, 1:16-18. Although Satterthwaite only discloses the term “gypsum,” a person having ordinary skill in the art would understand that the term “gypsum,” when used so broadly and in such context, may refer to any form of gypsum, including, for example, calcium sulfate hemihydrate (*i.e.* calcined gypsum) or calcium sulfate dihydrate (*i.e.* raw or set gypsum). NGC914-1006, 1:35-39. Moreover, the '914 patent states that acoustical tiles are one example of a set gypsum-containing product that is made with calcined gypsum. NGC914-1038, 1:66-2:2. As such, and because Satterthwaite’s disclosure is focused on the production of acoustical tiles, a person having ordinary skill in the art would understand that Satterthwaite’s recitation of the term “gypsum” could include calcined gypsum to form set-gypsum containing acoustical tiles.

169. Patent Owner may argue that Satterthwaite merely discloses gypsum

used as an inert filler and that it discloses starch as the binder that is crosslinked by STMP. Further, Patent Owner may argue that Satterthwaite's disclosure of gypsum is meant to refer only to the raw form and not calcined gypsum that is hydrated to create an interlocking matrix of set gypsum. This is incorrect. It would be a very small step for a person having ordinary skill in the art to replace gypsum as the binder or use gypsum as a co-binder along with starch as disclosed in Satterthwaite. In fact, the specification of the '914 patent specifically indicates that, as early as 1966, it was known in the art that acoustical ceiling tiles could be made using rehydrated calcium sulfate hemihydrate, *i.e.* set gypsum. NGC914-1038, 1:66-2:2; *see also* NGC914-1027. Further, it was well-known in the art prior to the earliest priority date of the '914 patent that gypsum could be either used as a filler or a binder and that when gypsum is to be used as a binding agent, the calcined form of gypsum is used so that when mixed with water, the hemihydrate form of gypsum hydrates to form calcium sulfate dihydrate, which is also known as set gypsum.

170. Moreover, Satterthwaite discloses including STMP as it describes “treating the starch in aqueous alkali slurry with reagents such as . . . sodium trimetaphosphate . . . or others which form cross-links between the starch molecules.” NGC914-1007, 2:9-13. Accordingly, a person having ordinary skill in the art would understand that Satterthwaite discloses this claim element.

171. Hjelmeland also teaches the inclusion of accelerators that “accelerate the hardening process.” NGC914-1008, Abstract. Accelerators are added to accelerate hardening of the gypsum-containing product. Indeed, a person having ordinary skill in the art would understand that adding an accelerator to the mixture would provide improved strength to set gypsum-containing products over those to which it was not added. Because Hjelmeland and Satterthwaite are in the very same field (*i.e.* set gypsum-containing products) as previously discussed, a person having ordinary skill in the art would understand that the accelerators disclosed by Hjelmeland can be used in the set gypsum-containing tile products of Satterthwaite.

172. It is sufficient that Satterthwaite discloses STMP; however, Satterthwaite specifically discloses STMP as an enhancing material. As stated, Satterthwaite discloses treating starch with STMP. NGC914-1007, 2:9-13. Enhancing materials are additives that improve at least one of resistance to permanent deformation, strength, and dimensional stability in set gypsum-containing products, with such enhancing materials including STMP. Satterthwaite further discloses that “the finished tile shows . . . increased resistance to warp or sag.” NGC914-1007, 1:60-62. Moreover, Satterthwaite states that “[w]hen used in tile making, my starch composition improves the wet tile characteristics, increases the wet tile strength and density, and increases the

resistance to sag or warp.” NGC914-1007, 4:24-27. A person having ordinary skill in the art would understand that Satterthwaite’s disclosures with regard to “wet tile characteristics” and “wet tile strength” pertain to tiles that have not yet entered the dryer, but Satterthwaite’s disclosures with regard to resistance to sag or warp pertain to tiles that have already been dried. Moreover, with regard to the “wet tile characteristics” and “wet tile strength,” a person having ordinary skill in the art would understand that tile having improved characteristics and strength while wet would also necessarily have improved characteristics and strength when dry. Accordingly, a person having ordinary skill in the art would understand that STMP is being used as an enhancing material, e.g., for improving at least one of resistance to permanent deformation, strength, and dimensional stability.

173. Indeed, Hjelmeland also discloses STMP. Although Hjelmeland discloses STMP as a “set retarding substance,” a person having ordinary skill in the art would understand that Hjelmeland uses the term “set retarding substance” to refer to STMP’s ability to extend the induction time of gypsum, which delays the time at which the gypsum begins to set and, as such, allows the gypsum to be manipulated without subjecting growing crystals to shear. In this regard, a person having ordinary skill in the art would understand that Hjelmeland teaches an interaction between STMP and gypsum that results in a product with at least increased core strength. *Id.* Accordingly, a person having ordinary skill in the art

would understand that STMP is being used as an enhancing material, e.g., for improving at least one of resistance to permanent deformation, strength, and dimensional stability. *Id.*

v. Claim 1e: maintaining the mixture under conditions sufficient for the calcined gypsum to form the interlocking matrix of set gypsum,

174. As stated, Satterthwaite discloses set gypsum-containing products as it is directed to the “manufacture of acoustical ceiling tile and other tile products made from a mixture of water, gypsum, mineral wool and other ingredients.” NGC914-1007, 1:16-18. Satterthwaite further discloses that the tile products are set gypsum-containing products and states that “the mixture is blended and formed into sheets, [t]he tile is then cut into sections, dried in an oven, cooled, cut, and processed for sale.” NGC914-1007, 3:40-42. A person having ordinary skill in the art would understand that set gypsum necessarily includes an interlocking matrix of set gypsum. In particular, the existence of an “interlocking matrix” of set gypsum is the reason that set gypsum-containing products have been used for centuries. Accordingly, a person having ordinary skill in the art would understand that Satterthwaite discloses this claim element.

vi. Claim 1f: the enhancing material or materials having been included in the mixture in an amount such that the gypsum board has greater sag resistance than it would have if the enhancing material had not been included in the mixture, said board having a sag resistance as determined according to ASTM C473-95 of less than about 0.1 inch per two foot

length of said board

175. As stated, Satterthwaite discloses STMP as it describes “treating the starch in aqueous alkali slurry with reagents such as . . . sodium trimetaphosphate . . . or others which form cross-links between the starch molecules.” NGC914-1007, 2:9-13. Satterthwaite further discloses that “the finished tile shows . . . increased resistance to warp or sag.” NGC914-1007, 1:60-62. Moreover, Satterthwaite discloses that “[w]hen used in tile making, my starch composition improves the wet tile characteristics, increases the wet tile strength and density, and increases the resistance to sag or warp.” NGC914-1007, 4:24-27. As previously discussed, a person having ordinary skill in the art would understand that Satterthwaite’s disclosures with regard to “wet tile characteristics” and “wet tile strength” pertain to tiles that have not yet entered the dryer, but Satterthwaite’s disclosures with regard to resistance to sag or warp pertain to tiles that have already been dried. Moreover, with regard to the “wet tile characteristics” and “wet tile strength,” a person having ordinary skill in the art would understand that tile having improved characteristics and strength while wet would also necessarily have improved characteristics and strength when dry.

176. In this regard, a person having ordinary skill in the art would understand that adding an “enhancing material” to the mixture would provide better resistance to deformation (e.g., sag resistance) than if it was not added.

However, a person having ordinary skill in the art would also understand that there is no standard amount of “enhancing material” to add to the mixture for forming a set gypsum-containing product. A person having ordinary skill in the art, understanding that the prior art discloses the inclusion of enhancing materials in a set gypsum-containing product, would find it obvious to include the enhancing materials in the mixture in amounts that provide for increased sag resistance and would have a reasonable expectation of success in doing so.

177. As stated, ASTM C473-95 teaches a method of testing for sag resistance. A person having ordinary skill in the art, understanding the similarities between ASTM C473-95, which teaches a test method for determining sag resistance, NGC914-1009, at ¶ 49, and Satterthwaite, would find it obvious to use ASTM C473-95 to test the sag resistance of the tile products of Satterthwaite and would have a reasonable expectation of success in doing so.

178. A person having ordinary skill in the art would understand that STMP was known in the art as improving the quality of set gypsum-containing products. Further, a person having ordinary skill in the art would understand that ASTM C473-95 measures one such quality, *i.e.* sag resistance. As stated, I understand from counsel that merely measuring an inherent property of an already-known composition does not make the composition patentable. Accordingly, a person having ordinary skill in the art would understand that the combination of

Satterthwaite and ASTM C473-95 discloses this claim element.

179. Moreover, as shown in FIGS. 2 and 3 of the '914 patent, set gypsum-containing products having sag of less than 0.1 inch were known in the art prior to the priority date of the '914 patent. For example, FIGS. 2 and 3 of the '914 patent illustrate the National Gypsum Company Gold Bond® High Strength Ceiling Board as having a sag resistance of .075 inches after 48 hours of testing, the same length of testing prescribed by ASTM C473-95. In this regard, the National Gypsum Company Gold Bond® High Strength Ceiling Board achieved improved sag resistance even better than the 0.1 inch requirement established by the '914 patent. Although the tests performed to provide the results illustrated in FIGS. 2 and 3 were not conducted in accordance with ASTM C473-95, it is my opinion that the tests used to produce the results illustrated in FIGS. 2 and 3 were conducted in harsher testing conditions that would cause more sag in the tested set gypsum-containing products due to the added weight from insulation and the potential for humidity to condense within the board core, as it does in real high humidity installations. NGC914-1038, 16:21-33. In this regard, the '914 patent identifies that boards already existed that satisfied this limitation. All the claim requires is satisfying this condition that had already been met by existing boards without explaining how this condition would be achieved. Therefore, the claim presumes that a person having ordinary skill in the art would understand how to create a ½

inch thick set gypsum-containing product that could meet the specified ASTM standard.

- vii. Claim 1g: the accelerator having been included in an amount such that the gypsum board has greater strength than it would have if the accelerator had not been included in the mixture.**

180. Accelerators are added to accelerate hardening of the gypsum-containing product. Indeed, a person having ordinary skill in the art would understand that adding an accelerator to the mixture would provide improved strength to gypsum-containing products over those to which it was not added by preventing the growth of crystals while the mass of activated hemihydrate is still subject to shear. However, a person having ordinary skill in the art would also understand that there is no standard amount of accelerator to add to the mixture for forming a set gypsum-containing product. Indeed, the amount of accelerator added to the mixture varies from day-to-day and plant-to-plant depending on various factors including temperature, production rates, etc. A person having ordinary skill in the art, understanding that the prior art discloses the inclusion of an accelerator in a set gypsum-containing product, would find it obvious to include the accelerator in the mixture in an amount that provides for increased strength and would have a reasonable expectation of success in doing so.

181. Moreover, Hjelmeland teaches that accelerators “accelerate the hardening process.” NGC914-1008, Abstract. Because Hjelmeland and

Satterthwaite are in the very same field (*i.e.* set gypsum-containing products) as previously discussed, a person having ordinary skill in the art would understand that the accelerators disclosed by Hjelmeland can be used in the set gypsum-containing tile products of Satterthwaite. Accordingly, a person having ordinary skill in the art would understand that a combination of Satterthwaite and Hjelmeland discloses this claim element.

viii. Claim 2: The gypsum board of claim 1, wherein the concentration of the enhancing material in the mixture is from 0.004 to 2.0 percent by weight, based on the weight of the calcined gypsum.

182. As stated, Satterthwaite discloses STMP as it describes “treating the starch in aqueous alkali slurry with reagents such as . . . sodium trimetaphosphate . . . or others which form cross-links between the starch molecules.” NGC914-1007, 2:9-13. Hjelmeland discloses a set gypsum-containing product, which includes “a set retarding substance comprising (i) an organic acid containing at least two acid groups selected from the group consisting of . . . phosphate or phosphonate . . . and/or (ii) inorganic anions selected from the group consisting of polyphosphate” NGC914-1008, 3:60-4:2. Hjelmeland further discloses that “the set retarding substance constitutes . . . 0.01-0.2% . . . by weight of the gross water quantity in the first component.” NGC914-1008, 4:13-15. Accordingly, person having ordinary skill in the art would further understand that Hjelmeland discloses the addition of the “set retarding substance” in the claimed range.

Further, a person having ordinary skill in the art would understand that the “set retarding substance” of Hjelmeland includes STMP.

183. Although Hjelmeland discloses STMP as a “set retarding substance,” a person having ordinary skill in the art would understand that, as with many reagents, the accelerating and retarding effects of STMP vary based on pH. Indeed, a person having ordinary skill in the art would understand that at a high pH STMP acts as a retarder, and at a lower pH STMP acts as an accelerator. A person having ordinary skill in the art would also understand that Hjelmeland is primarily directed to the use of plaster, which has a high pH. As such, a person having ordinary skill in the art would understand that because the plaster is at a high pH, STMP will act as a retarder. Moreover, a person having ordinary skill in the art would understand that Hjelmeland uses the term “set retarding substance” to refer to STMP’s ability to extend the induction time of gypsum, which delays the time at which the gypsum begins to set and, as such, allows the gypsum to be manipulated without subjecting growing crystals to shear. Indeed, STMP increases the core strength of the set gypsum-containing product because it allows a greater proportion of crystals to grow undisturbed. In this regard, a person having ordinary skill in the art would understand that Hjelmeland teaches an interaction between STMP and gypsum that results in a product with at least increased core strength.

184. A person having ordinary skill in the art would understand that the set retarding substance of Hjelmeland is a condensed phosphoric acid or ion of a condensed phosphate. Moreover, a person having ordinary skill in the art would understand that STMP, as disclosed by Satterthwaite, is a salt of a condensed phosphate. As such, a person having ordinary skill in the art, understanding the similarities between Hjelmeland, which discloses the amount of condensed phosphoric acid or ion of condensed phosphate to include in a set gypsum-containing product, NGC914-1008, 4:13-15, and Satterthwaite, would find it obvious to use approximately the amount of condensed phosphate specified by Hjelmeland in the tile products of Satterthwaite and would have a reasonable expectation of success in doing so. I understand from counsel that when the prior art discloses a range that falls within the claimed range, the claimed range is obvious over the prior art. Accordingly, a person having ordinary skill in the art would understand that the combination of Satterthwaite and Hjelmeland discloses this claim element.

185. A person having ordinary skill in the art would understand that the water quantity in Hjelmeland can be equated with the calcined gypsum quantity in Hjelmeland. In particular, for the applications described by Hjelmeland, a person having ordinary skill in the art would understand that a water/stucco ratio of 0.66 is used. As such, although Hjelmeland discloses that “the set retarding substance

constitutes . . . 0.01-0.2% . . . by weight of the gross water quantity in the first component,” NGC914-1008, 4:13-15, this range equates to an amount of enhancing material of 0.0066-0.132% by weight of the calcined gypsum. Moreover, Examples 15 and 16 of Hjelmeland teach the use of an amount enhancing material of 0.033% by weight of the calcined gypsum. NGC914-1008, 12:24-26, 12:48-50.

186. In addition, a person having ordinary skill in the art would find a range of “enhancing material” from 0.004% to 2.0% by weight to be extremely broad. Indeed, 0.004% of an “enhancing material” is significantly less than necessary, while 2.0% is significantly more than necessary. As such, a person having ordinary skill in the art would not consider this range to be a true limitation of the claim.

ix. Claim 3: The gypsum board of claim 1, wherein the calcined gypsum comprises one or more of: calcium sulfate anhydrite; calcium sulfate hemihydrate; or ions of calcium and sulfate.

187. As stated with respect to Claim 1a, Satterthwaite discloses set gypsum-containing products as it is directed to the “manufacture of acoustical ceiling tile and other tile products made from a mixture of water, gypsum, mineral wool and other ingredients.” NGC914-1007, 1:16-18. As discussed above, although Satterthwaite only discloses the term “gypsum,” a person having ordinary skill in the art would understand that the term “gypsum,” when used so broadly and in

such context, may refer to any form of gypsum, including, for example, calcium sulfate hemihydrate (*i.e.* calcined gypsum) or calcium sulfate dihydrate (*i.e.* raw or set gypsum). NGC914-1006, 1:35-39. Moreover, the '914 patent states that acoustical tiles are one example of a set gypsum-containing product that is made with calcined gypsum. NGC914-1038, 1:66-2:2. As such, and because Satterthwaite's disclosure is focused on the production of acoustical tiles, a person having ordinary skill in the art would understand that Satterthwaite's recitation of the term "gypsum" could include calcined gypsum to form set-gypsum containing acoustical tiles, which is synonymous with calcium sulfate hemihydrate.

188. Patent Owner may argue that Satterthwaite merely discloses gypsum used as an inert filler and that it discloses starch as the binder that is crosslinked by STMP. Patent Owner may further argue that the gypsum disclosed by Satterthwaite is the raw form of gypsum and not the calcined gypsum that is hydrated to create an interlocking matrix of set gypsum. It would be a very small step for a person having ordinary skill in the art to replace gypsum as the binder or use gypsum as a co-binder along with starch as disclosed in Satterthwaite. In fact, the specification of the '914 patent specifically indicates that, as early as 1966, it was known in the art that acoustical ceiling tiles could be made using rehydrated calcium sulfate hemihydrate, *i.e.* set gypsum. NGC914-1038, 1:66-2:2; *see also*, NGC914-1027. Further, it was well-known in the art prior to the earliest priority

date of the '914 patent that gypsum could be either used as a filler or a binder and that when gypsum is to be used as a binding agent, the calcined form of gypsum, calcium sulfate hemihydrate, is used so that when mixed with water, the hemihydrate form of gypsum hydrates to form calcium sulfate dihydrate, which is also known as set gypsum. Accordingly, a person having ordinary skill in the art would understand that Satterthwaite discloses this claim element.

- x. **Claim 4: The gypsum board of claim 1, wherein the enhancing material comprises one or more of the following salts, or the anionic portions thereof: sodium trimetaphosphate and ammonium polyphosphate having 1000-3000 repeating phosphate units**

189. As stated, Satterthwaite discloses STMP as it describes “treating the starch in aqueous alkali slurry with reagents such as . . . sodium trimetaphosphate . . . or others which form cross-links between the starch molecules.” NGC914-1007, 2:9-13. Accordingly, a person having ordinary skill in the art would understand that Satterthwaite discloses this claim element.

- xi. **Claim 6: The gypsum board of claim 1, wherein the mixture further comprises a pregelatinized starch.**

190. As stated, pregelatinized starch undergoes a pretreatment process in which the starch is heated and processed to increase the starch's ability to absorb water. In this regard, pregelatinized starch has a higher ability to absorb water than non-pregelatinized starch. Accordingly, the primary difference between pregelatinized starch and non-pregelatinized starch is that pregelatinized starch has

a higher ability to absorb water as a result of the pregelatinization process.

Accordingly, less pregelatinized starch may be used to achieve the same effect as the same starch in a non-pregelatinized form during the gypsum board manufacturing process.

191. Satterthwaite further discloses processing starch by, for example, gelatinization. NGC914-1007, 1:13-18; 2:34-46. Moreover, Satterthwaite discloses crosslinking starches. NGC914-1007, 2:9-13. A person having ordinary skill in the art would understand that pregelatinization and crosslinking of starches accomplish substantially the same purpose – increasing the starch’s ability to absorb water to improve the strength and/or sag resistance of a gypsum board. Indeed, a person having ordinary skill in the art would understand that a crosslinked starch has more potential to add strength and/or sag resistance to a set gypsum-containing product. Therefore, whether the starch is pregelatinized or crosslinked later, the desirability of the crosslinking is the same. A person having ordinary skill in the art, therefore, would understand that Satterthwaite contemplates pregelatinized starch as it discloses that gelatinization of starch and crosslinking of starch.

192. Moreover and as previously discussed, a person having ordinary skill in the art would understand that either pregelatinized starch or other non-pregelatinized starches may be used in set gypsum-containing products. Indeed,

using pregelatinized starch allows, in many cases, less overall starch to be used in the production of set gypsum-containing products because pregelatinized starch has a higher ability to absorb water than other starches. In this regard, pregelatinized starch confers certain beneficial properties such as improved mix rheology, bubble structure, and dry strength. However, similar outcomes can be achieved by adding more volume of other non-pregelatinized starches. Accordingly, the use of pregelatinized starch was a known alternative to other starches to a person having ordinary skill in the art.

xii. Claim 8: The gypsum board of claim 1, wherein: the core has voids uniformly distributed therein; and the mixture further comprises an aqueous foam.

193. The specification of the '914 patent discloses U.S. Pat. No. 5,643,510 to Sucech, which discloses the use of foaming agents in order to “produce[] a multiplicity of large voids *substantially uniformly distributed* throughout the foamed gypsum core.” NGC914-1036, 5:12-14 (emphasis added); NGC914-1038, 9:53-62. Moreover, the specification states that

In embodiments of the invention that employ a foaming agent to yield voids in the set gypsum-containing product to provide lighter weight, any of the conventional foaming agents known to be useful in preparing foamed set gypsum products can be employed. . . . For further descriptions of useful foaming agents, see, for example: U.S. Pat. Nos. . . . 5,643,510 . . .

NGC914-1038, 9:53-62 (citing NGC914-1036). As stated, a person having

ordinary skill in the art, understanding the similarities between Sucech, which discloses the use of foaming agents in production of set gypsum-containing products to lower their weight and density, NGC914-1036, 1:30-35, 5:12-14, and Satterthwaite, would find it obvious to add a foaming agent as taught by Sucech to the set gypsum-containing products of Satterthwaite and would have a reasonable expectation of success in doing so. Indeed, a person having ordinary skill in the art would understand that foaming agents are necessarily used in set gypsum-containing products in order to reduce the density of the products, increase ease of handling, increase thermal insulation and sound proofing, decrease drying time, reduce brittleness of the product, and decrease the use of raw gypsum. A person having ordinary skill in the art would understand that foaming agents are used to control the density of the board, which, in turn, helps provide strength to the gypsum board while lowering its weight and bulk density.

194. Indeed, a person having ordinary skill in the art would understand that foaming agents are necessarily used in set gypsum-containing products in order to reduce the density of the products, increase ease of handling, increase thermal insulation and sound proofing, decrease drying time, and decrease the use of raw gypsum.

- xiii. Claim 10: The gypsum board of claim 1, wherein the mixture further comprises a pregelatinized starch and an aqueous foam.**

195. As stated, pregelatinized starch undergoes a pretreatment process in which the starch is heated and processed to increase the starch's ability to absorb water. In this regard, pregelatinized starch has a higher ability to absorb water than non-pregelatinized starch. Accordingly, the primary difference between pregelatinized starch and non-pregelatinized starch is that pregelatinized starch has a higher ability to absorb water as a result of the pregelatinization process. Accordingly, less pregelatinized starch may be used to achieve the same effect as the same starch in a non-pregelatinized form during the gypsum board manufacturing process.

196. Satterthwaite further discloses processing starch by, for example, gelatinization. NGC914-1007, 1:13-18; 2:34-46. Moreover, Satterthwaite discloses crosslinking starches. NGC914-1007, 2:9-13. A person having ordinary skill in the art would understand that pregelatinization and crosslinking of starches accomplish substantially the same purpose – increasing the starch's ability to absorb water to improve the strength and/or sag resistance of a gypsum board. Indeed, a person having ordinary skill in the art would understand that a crosslinked starch has more potential to add strength and/or sag resistance to a set gypsum-containing product. Therefore, whether the starch is pregelatinized or crosslinked later, the desirability of the crosslinking is the same. A person having ordinary skill in the art, therefore, would understand that Satterthwaite

contemplates pregelatinized starch as it discloses that gelatinization of starch and crosslinking of starch.

197. Moreover and as previously discussed, a person having ordinary skill in the art would understand that either pregelatinized starch or other non-pregelatinized starches may be used in set gypsum-containing products. Indeed, using pregelatinized starch allows, in many cases, less overall starch to be used in the production of set gypsum-containing products because pregelatinized starch has a higher ability to absorb water than other starches. In this regard, pregelatinized starch confers certain beneficial properties such as improved mix rheology, bubble structure, and dry strength. However, similar outcomes can be achieved by adding more volume of other non-pregelatinized starches. Accordingly, the use of pregelatinized starch was a known alternative to other starches to a person having ordinary skill in the art.

198. The specification of the '914 patent discloses U.S. Pat. No. 5,643,510 to Sucech, which discloses the use of foaming agents in order to “produce[] a multiplicity of large voids *substantially uniformly distributed* throughout the foamed gypsum core.” NGC914-1036, 5:12-14 (emphasis added); NGC914-1038, 9:53-62. Moreover, the specification states that

In embodiments of the invention that employ a foaming agent to yield voids in the set gypsum-containing product to provide lighter weight, any of the conventional foaming agents known to be useful in

preparing foamed set gypsum products can be employed. . . . For further descriptions of useful foaming agents, see, for example: U.S. Pat. Nos. . . . 5,643,510

NGC914-1038, 9:53-62 (citing NGC914-1036).

199. As stated, a person having ordinary skill in the art, understanding the similarities between Sucech, which discloses the use of foaming agents in production of set gypsum-containing products to lower their weight and density, NGC914-1036, 1:30-35, 5:12-14, and Satterthwaite, would find it obvious to add a foaming agent as taught by Sucech to the set gypsum-containing tile products of Satterthwaite and would have a reasonable expectation of success in doing so. Indeed, a person having ordinary skill in the art would understand that foaming agents are necessarily used in set gypsum-containing products in order to reduce the density of the products, increase ease of handling, increase thermal insulation and sound proofing, maintain core strength, decrease drying time, reduce brittleness of the product, and decrease the use of raw gypsum. A person having ordinary skill in the art would understand that foaming agents are used to control the density of the board, which, in turn, helps provide strength to the gypsum board while lowering its weight and bulk density.

X. SECONDARY CONSIDERATIONS

200. As mentioned above, secondary considerations are part of the obviousness determination.

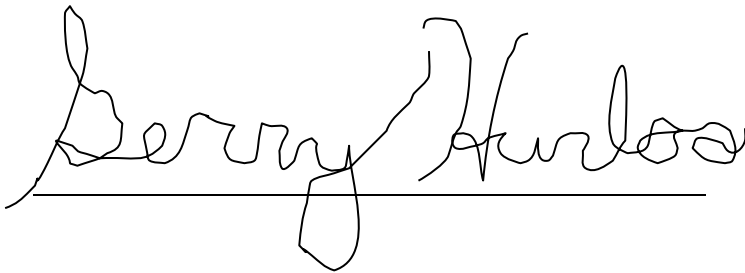
201. I note that Patent Owner will be unable to prove a nexus between any commercial success and the '914 patent at least because the product that Patent Owner is expected to identify for purposes of commercial success was not developed until 2010, thirteen years after the priority date of the '914 patent, and twelve years after Patent Owner allegedly incorporated STMP into its products.

202. To the extent any “long-felt need” for products that satisfy the sag resistance criterion recited in the patent would have existed, it would have been met by any one of the various gypsum boards sold by, for example, National Gypsum, CertainTeed, Georgia-Pacific, American Gypsum, Continental Building Products, PABCO, and the like. Indeed, and as stated, the '914 patent discloses National Gypsum's Gold Bond® High Strength Ceiling Board as having a sag resistance of .075 inches after 48 hours of testing, the same length of testing prescribed by ASTM C473-95. NGC914-1038, Figs. 2 & 3. In this regard, the '914 patent identifies that National Gypsum's existing boards satisfied any purported need for sag resistance “of less than about 0.1 inch per two foot length” of board.

XI. CONCLUSION

203. Based on my findings above, it is clear to me that the Challenged Claims are not patentable in light of the grounds of rejection outlined herein.

I hereby declare that all statements made herein of my own knowledge are true and that all opinions expressed herein are my own; and further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

A handwritten signature in cursive script, appearing to read "Jerry Hurdoo", written over a horizontal line.

28/04/17
Date

Exhibit A

Curriculum Vitae

19 January, 2017
27 Damude Drive
Fonthill, Ontario
CANADA
L0S 1E0

Mr. Ross Barton

Re: CV of Robert Gerry Harlos

I graduated with an Honours Bachelor of Science degree in Chemistry from the University of Calgary in 1971. I worked for a consulting engineering firm that serviced the sulfur removal industry in natural gas fields of western Canada for 2.5 years. During the next 14.5 years I worked for Dow Chemical Canada Inc. in various technical management positions, manufacturing chlorinated hydrocarbons, designing automated analytical systems, and manufacturing polystyrene. In the last five years of my Dow time, we engaged in the advanced practices of statistical process control.

In 1988 I joined Domtar Gypsum Inc., as the Division Quality Manager, with responsibilities for product quality assurance in eleven gypsum board plants, two internal paper mills, two external paper suppliers, and a number of gypsum rock suppliers. I actively managed and improved quality in most of these operations. Core projects included designing the quality assurance programmed for CD Ceiling Board, implementation of effective stucco mass metering designs, assessment of new technologies for dense layer application to gypsum papers, board weight reduction, inter-laboratory testing assessment, plant quality system assessment (pre-ISO 9000), inter-plant technology transfer. Georgia-Pacific Gypsum acquired the assets of Domtar Gypsum in 1996, consolidating their operations without a significant portion of the Canadian management staff.

I commenced operations as an independent technical consultant in mid-1996. I have engaged in optimization and problem solving in over forty gypsum board plants and ten gypsum paper mills; located in North America, but also in the UAE, Indonesia, Thailand, Japan, South Korea, Peru, Colombia, Argentina, Paraguay, Mexico, Portugal, Germany and France. My clients include ABB-Ehrsam, ABB-Susa, Grenzebach GmbH, Atlantic Gypsum, BMH Americas, Caraustar Industries, Continental Gypsum, Precor Gypsum, Georgia-Pacific Gypsum, Gypsemna LLC, Hanatec Gypsum, Paneltec Gypsum, LaFarge Gypsum, James Hardie Gypsum, British Plasterboard, Pabco Gypsum, Panel Rey Gypsum, Republic Group, Standard Gypsum, United States Gypsum, Voith GmbH, and Weig Technokarton GmbH.

Between 1997 and 1999, I consulted heavily in the expansion of the Republic Gypsum plant at Duke, Oklahoma to become, for a short time, the largest single wallboard production facility in the world; with a production capacity of one billion square feet per year. I joined that company as the Director of Technical and Quality Systems in 1999. I was involved with the design, commissioning, and management of that facility and the commissioning of a new 600 M/min paper machine at Lawton Oklahoma. My relationship with the company ended when it merged into Centex/American Gypsum with its own management group. I resumed full-time consulting in the summer of 2000. Clients request my efforts for special projects, problem solving, and training. I have built a superb turn-key foam system to replace one of inferior design in a Chinese-supplied plasterboard plant.

Throughout my career, I have been a consistent problem solver at the center of positive change and new technologies, including precision board weight control, foam optimization, skim coating, and dryer optimization. I have provided assistance in most phases of a plasterboard project from site layout to the broadening of product mix in response to customer requirements:

- ☐ Raw materials assessment and selection
- ☐ Site assessment and planning
- ☐ Constructor contract negotiation
- ☐ Erector/Customer interface
- ☐ Erection inspection and technical support
- ☐ Technical staff selection and training
- ☐ Laboratory design/procurement
- ☐ Complete suite of test methods for process diagnostics, product assessment
- ☐ Pre-start-up operator training
- ☐ Factory commissioning in conjunction with the constructor
- ☐ Calcine optimization: grind, combined water, capacity; direct/indirect heat
- ☐ Stucco storage design, optimization, ventilation
- ☐ Wet metering design, retro-fit of wet/dry mass metering
- ☐ Mixer set-up, wear diagnostics and repair
- ☐ Dense layer slurry retro-fits, design and operation
- ☐ Dryer diagnostics and re-balancing
- ☐ Product formulation optimization
- ☐ Board weight reduction
- ☐ Post start-up on-going consultation
- ☐ Statistical product analysis for gypsum paper mills and gypsum board plants
- ☐ Process control, and process optimization for board plants or gypsum paper mills

I would be pleased to engage in further discussions about your needs for technical assistance.

Sincerely,



Gerry Harlos